consulting engineer

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Engineering Appraisals
Specifying Cooling Towers
Toward Zero Absolute
Atomic Power
Subcontracting Drafting
Brazil's Industry
Torque and Speed
for Management
Waste Disposal

July 1953

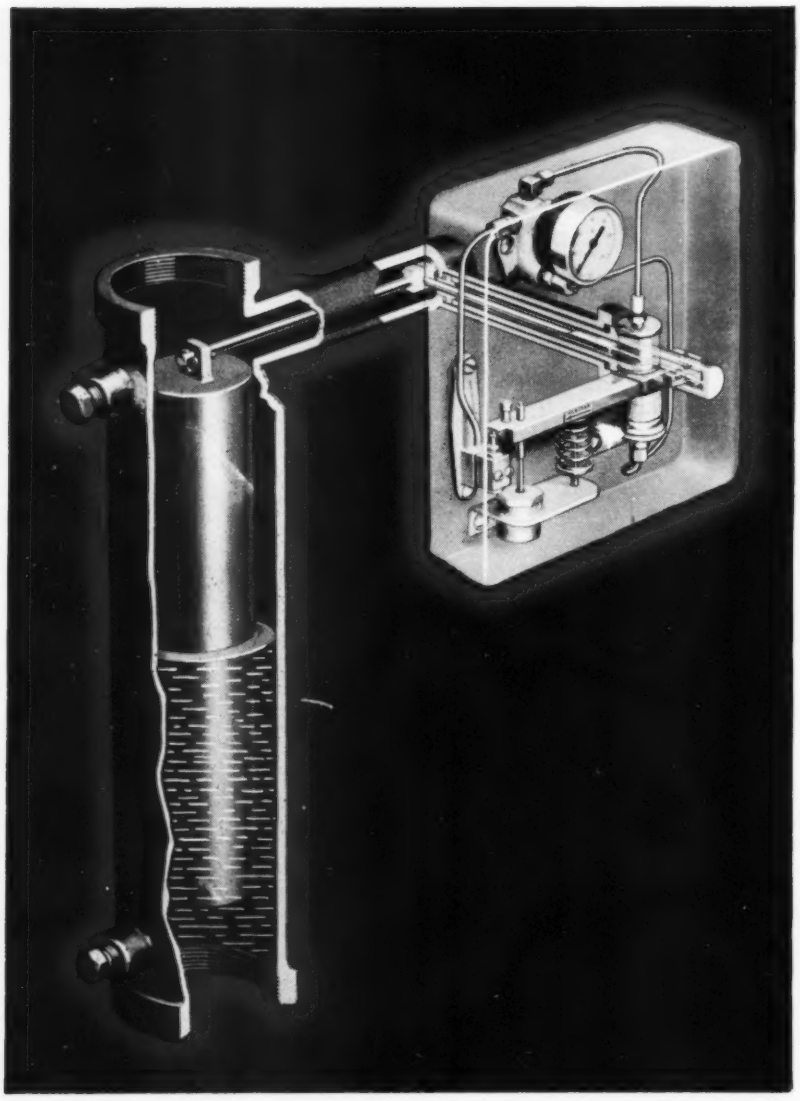
. . . our technology is sound

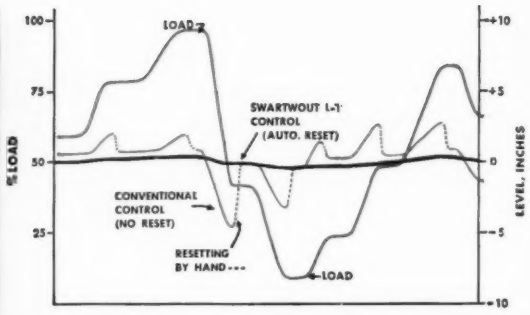
Boss of the Reactors

LAWRENCE R. HAFSTAD grew up in Minneapolis, now tends a farm as a weekend hobby in Maryland. Between these two matter-of-fact happenstances, Hafstad came to be boss of this country's effort to make something useful out of the nuclear fission process — he is director of the Atomic Energy Commission's division of reactor development. Hafstad's steady

(Continued on page 8)

Hold liquid levels within ±1/2 inch automatically with Swartwout L1 Displacement Type Controls



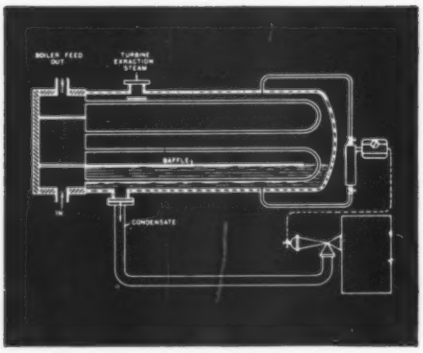


1 Precise control of liquid level from no load to full load without manual readjustment is provided by Swartwout L1 Controls. Setback and reset features compensate for quick-changing loads or long process lags . . . eliminate any tendency to cycle or hunt, yet permit control within narrow range of ±½ inch. Graph *(above)* shows precision of L1 compared with conventional control on applications where level must be maintained within ±½ inch.

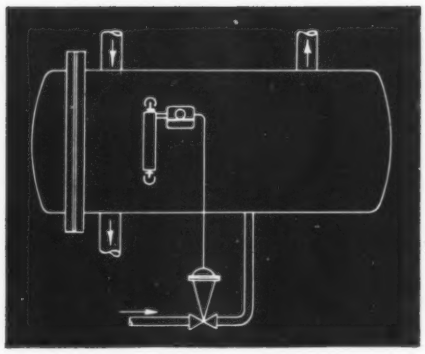
Operating on balance of forces principle, there is little actual movement of parts. Torque tube design eliminates stuffing boxes . . . gives continuous leakproof operation. Since changes in liquid level vary effective weight of displacement type float, L1 Controls can also be used for throttling over full length of float, available in lengths from 15 to 120 inches. A-3696

Swartwout

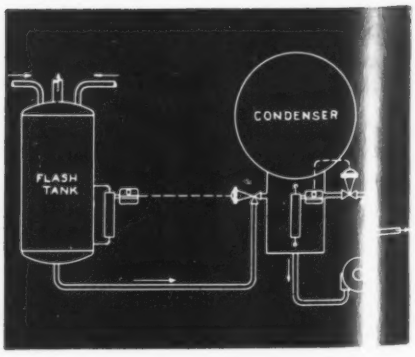
POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
INDUSTRIAL VENTILATION



2 Horizontal Subcooled Heaters—L1 Control holds level to ±½ inch, never lets condensate cover tubes that should be exposed to steam . . . never exposes tubes that should be covered with condensate.



3 Evaporators—Swartwout L1 Displacement Type Control holds level within ±½ inch . . . prevents carryover of solids and contamination of boiler feed water. Increased plant efficiency results.



4 Flash Tanks—Level maintained in some installations, by L1 Control draining to condenser. Hot well level precisely maintained by controlling condensate recirculation from pump discharge.

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VOLUME 2
NUMBER 5

consulting engineer

JULY 1953

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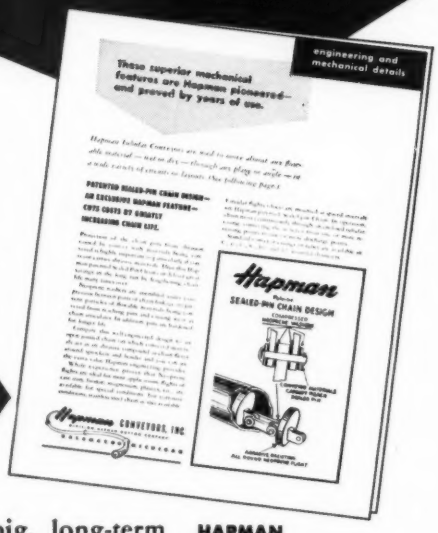
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WRITE FOR NEW BULLETIN CE-753.

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Below: Illustration from new bulletin shows conveyor discharging metal chips into tote box.

Hapman CONVEYORS, INC.
DIVISION HAPMAN-DUTTON COMPANY
KALAMAZOO MICHIGAN

Very truly yours

THE MOST FREQUENT comment we received from you when we first got underway with publishing plans for CONSULTING ENGINEER added up to something like this: "We welcome CONSULTING ENGINEER because we feel it will help to promote the welfare of the consulting engineer (1) by informing the public on the advantages of the consulting engineer's services and (2) by welding all true consulting engineers into one group with the thought of establishing Engineering as a Profession."

Since the basic purpose of this publication is to serve consulting engineers everywhere, we will work with full vigor to "promote the welfare of the profession." Our current advertising campaign, for example, is built on the theme, "How do consulting engineers influence YOUR sales results?" In this advertising we point to outstanding specifics and close with a summary which goes like this: "Their functions range from pure research in the laboratory on through completed projects in every engineering realm—civil, architectural, chemical, electrical, mechanical, hydraulic, aeronautical, mining, heating, ventilating, air conditioning, materials handling, structural, machine design . . . as well as the business management areas of economics, operating methods, efficiency, and long-range planning."

CONSULTING ENGINEER will continue to become an increasingly strong unifying force among consultants through the exchange of ideas and methods. With this unifying force, the professional status of the consulting engineer will become further enhanced and more widely accepted. However, CONSULTING ENGINEER cannot achieve this Utopia single-handedly. A great deal depends upon an effectively unified organization which also can work constantly for the recognition and acceptance which the consulting engineering profession has earned and must receive in order to achieve its full stature.

Very truly yours,

M. J. Sanders

Publisher

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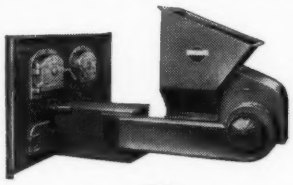
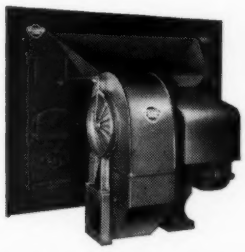


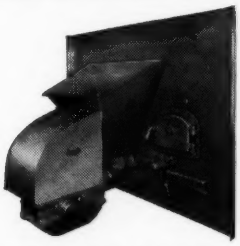
THE DURAFLEX DELUXE WORMFEED

Includes ash dump grates, unit or divided drive. For loads up to 275 H. P.



THE VULCAN RAMFEED

For use where steam demands vary rapidly and service conditions are severe. For loads up to 800 H. P.



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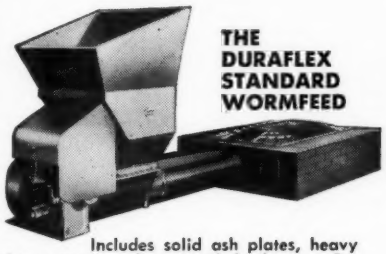

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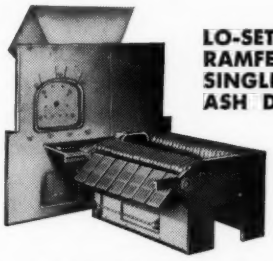
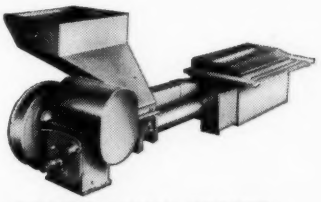
Includes solid ash plates, heavy duty tuyeres and sectional feedworm. For loads up to 275 H. P.



LO-SET RAMFEED SINGLE ASH DUMP

For special or very narrow furnaces or boiler fireboxes.



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For ceramic kiln firing.

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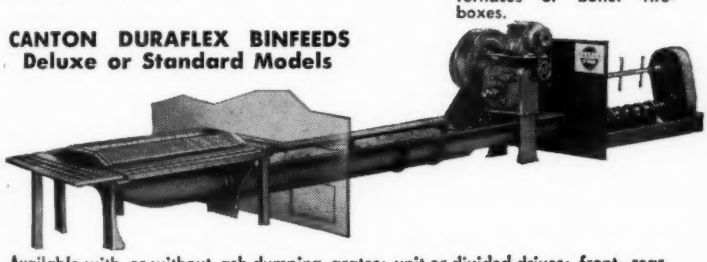
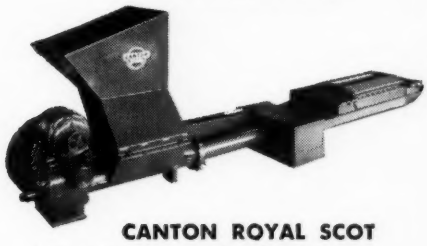
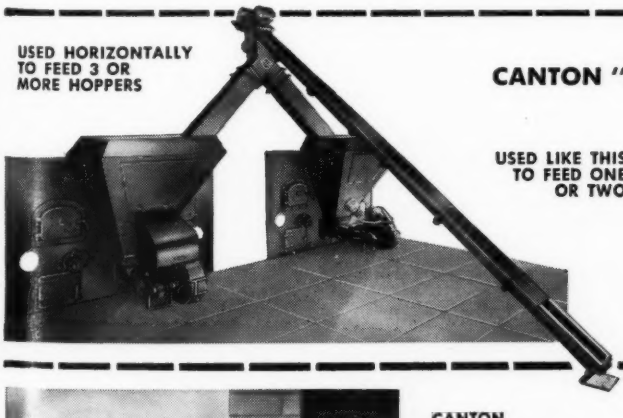


Available with or without ash dumping grates; unit or divided drives; front, rear or side boiler entry; ash sprays and furnace fronts. For loads up to 275 H. P.



CANTON ROYAL SCOT

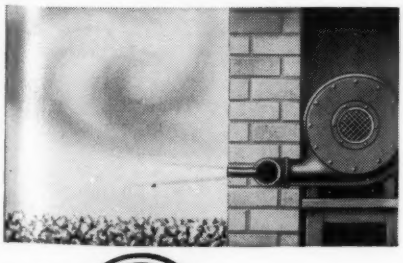
A unit type wormfeed stoker for automatically, efficiently firing Scotch Marine boilers.



CANTON "FLO-TUBE" HEAVY DUTY CONVEYORS

Screw type conveyors deliver coal from bin or pile automatically . . . free men for more exacting duties. "Off-on" switches will maintain desired levels in hoppers. Capacities to 10,000 lbs. per hour. Also widely used for conveying other materials such as steel chips, grain, pellets, wood waste, sand, etc.

COAL ENTERS EXPOSED END



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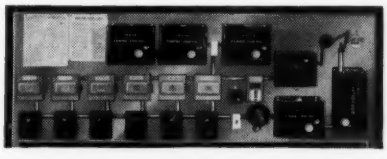

CANTON "SYNCHRO" COMBUSTION CONTROLS

Automatically adjusts fuel feed, air supply, boiler draft and combustion rates in proportion to steam demand or water and weather temperatures. Applicable to other forms of proportioning control.

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Boss of the Reactors

—Starts on Front Cover

climb to engineering eminence began in Minneapolis' public education system, continued through the University of Minnesota and Johns Hopkins, where he picked up his doctorate.

Reactors and the Future

The professional future for Hafstad seems more and more likely to overshadow his rewarding past. His is the assignment for the world leadership in nuclear reactor development that we as a nation unquestioningly desire to maintain. There are no qualms in his attitude—"Successes with reactors built to date, show that our knowledge of technology is sound.

"Cost estimating at present is necessarily uncertain, but studies by utility and industrial engineers show that nuclear power plants designed primarily to produce low cost electric power are close to being able to compete at the present time. This can be taken to mean that the cost of installed capacity is in the neighborhood of $200 per kilowatt.

"This does not solve the industrial power problem by any means, for while a precision of ± 10 percent would represent a miracle as an estimate for construction, the entire tolerance range would have to be below competitive power costs to permit private financing." This does not include the costs to be reckoned with in developing present technology to the point where it would warrant a go-ahead on a full-scale, fission-fuel power plant.

Hafstad's professional past includes significant patents and outstanding contributions to the nation's technology while in the government service. Far more than an ordinary share of memberships, honorary appointments, and awards have come his way. But perhaps the crowning touch was the conferring of the Medal of Merit for his major contribution to the war effort on the scientific front.

Atomic Power Here

Where does the future of atomic energy point as a primary source of power? Hafstad answers, "Atomic power in quantity can now be taken for granted as available if and when needed. The degree of need will determine the vigor of development efforts, which in turn will determine how rapidly costs will be reduced. Since we are blessed with ample fossil fuel reserves, it is probable that first really practical use of nuclear power will be made abroad."

"In due course, with rising coal and oil prices, nuclear power should begin to supplement conventional power sources, even in the United States. Since fuel costs are only a fraction of power costs, and since uranium serves only as an alternate fuel, no real industrial revolution is expected."

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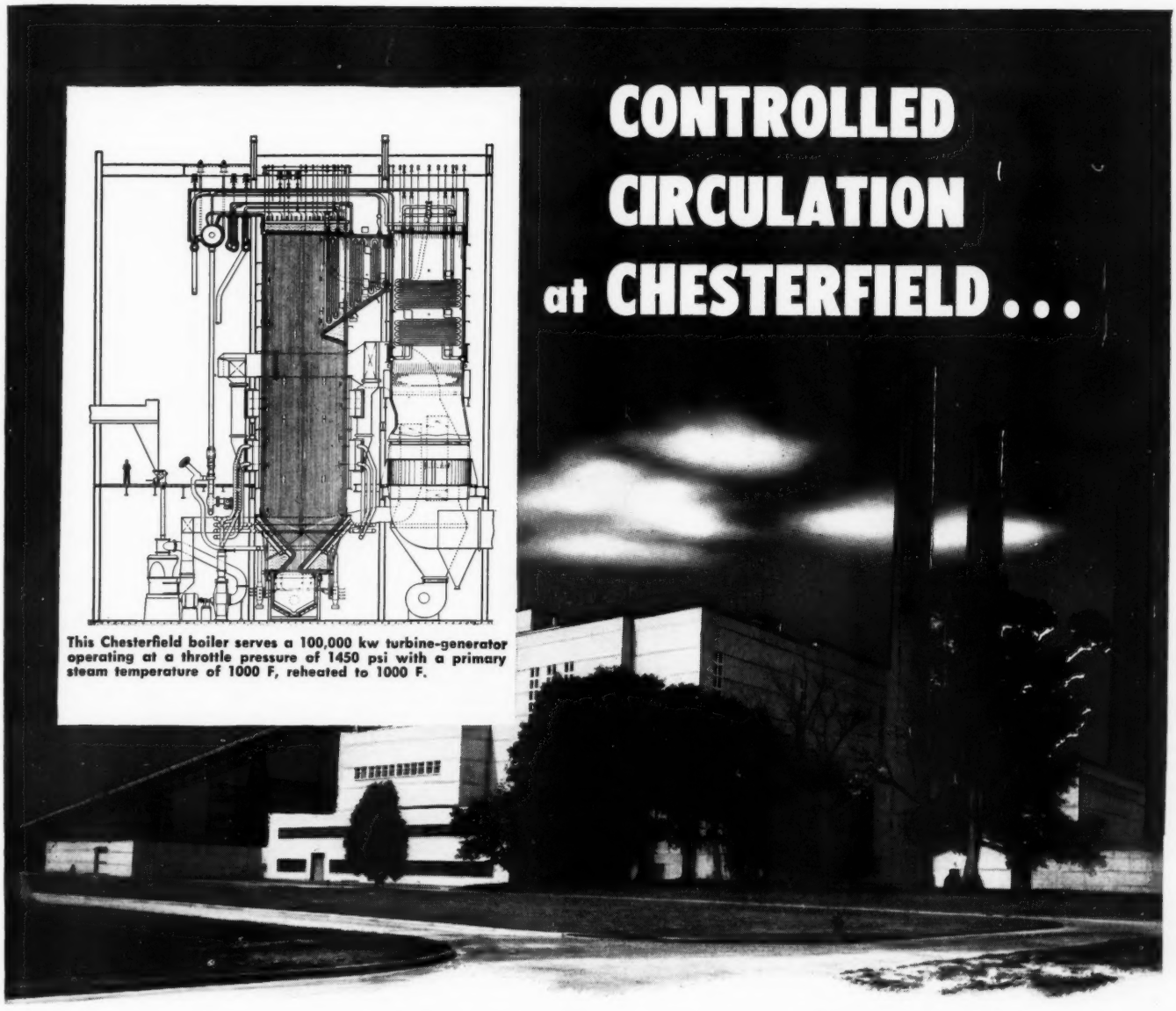

This Chesterfield boiler serves a 100,000 kw turbine-generator operating at a throttle pressure of 1450 psi with a primary steam temperature of 1000 F, reheated to 1000 F.

. . . meets all expectations

The Chesterfield Power Station of Virginia Electric and Power Company at Wheelwright, near Richmond, Virginia, placed in regular commercial service the first postwar controlled-circulation boiler on December 1, 1952.

Although a completely new design, it achieved ideal performance characteristics from the start, and, with the exception of one scheduled inspection, has been in continuous service ever since. All of the anticipated operating and economic advantages of this new design have been fully realized. It is significant, too, that with new capacity urgently required by the system, the Chesterfield unit was turning out kilowatts just 28 months from the date of order.

The Virginia Electric and Power Company and its designing and construction engineers, Stone & Webster Engineering Corporation, have further confirmed their confidence in controlled circulation by placing orders for three duplicate boilers, two for their new Portsmouth Station and one for their Possum Point Station.

Moreover, leading utility companies now have in service, under construction and on order C-E Controlled Circulation Boilers to serve a total generating capacity of 5,000,000 kw.

Controlled Circulation — pioneered by Combustion in this country for large power boilers — is just one more C-E contribution to American power practice.

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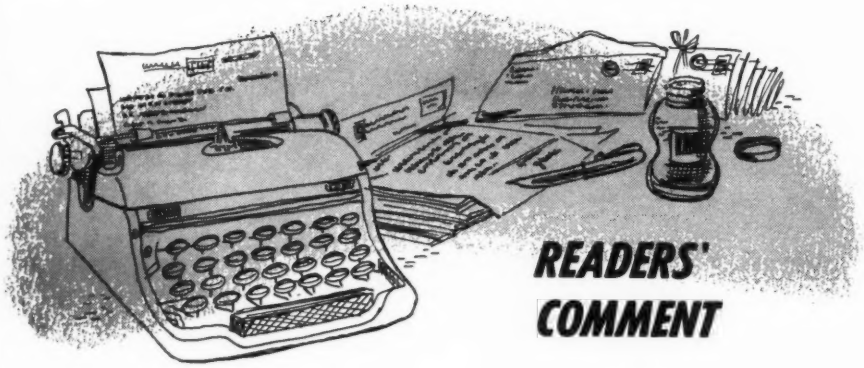

READERS' COMMENT

CE is Indexed

Sir:

We are pleased that you are adding our library to your mailing list for all subsequent copies of CONSULTING ENGINEER.

The Engineering Index has examined the copies already received and says that they will index these and future issues, so long as they maintain present standards. They will be pleased to have you state in the masthead that CONSULTING ENGINEER is indexed in Engineering Index.

We look forward to the receipt of the issues subsequent to April, 1953.

Ralph H. Phelps, Director
Engineering Societies Library
New York, New York

Home or Office

Sir:

A few weeks ago you published a note or form asking whether your magazine should be sent to home addresses rather than to the office. At the moment I was too busy to take advantage of it, but wish now that you would do so and am enclosing the front of the last envelope with the change marked on it.

May I compliment you not only on the mechanical makeup of the magazine, but particularly on the choice of subject matter in its interest to men in work such as I am doing.

H. D. Fisher
Consulting Engineer
Westcott & Mapes, Inc.
New Haven, Conn.

Engineers Want CE

Sir:

My copy of the current issue of CONSULTING ENGINEER was loaned to two associates and both asked the same questions, "Where can I subscribe to CE and what is the price?" Because it is my belief that they qualify under your provisions I am submitting their names.

CONSULTING ENGINEER could be still more valuable to me and perhaps others concerned with administrative functions of management if it were possible to give a bit more consideration to Management Engineering. Over-all I appreciate the magazine and offer the above only as a suggestion of what I think would make it still better.

Winston I. Parks
T. A. B. Engineers, Inc.
Chicago, Ill.

● THREE ARTICLES IN THIS ISSUE COVER PHASES OF MANAGEMENT ENGINEERING —ED.

Likes McDonald's Article

Sir:

I was very much interested in the article by Mr. Frederick H. McDonald in the June issue of CONSULTING ENGINEER. Would it be possible for you to furnish me his business address, together with the information as to the type of consulting practice he is handling at the present time?

I would like to contact and correspond with Mr. McDonald personally relative to his article, which I felt was one of the outstanding discussions ever published on the ethics of our profession.

Charles E. Hatch
Charles E. Hatch & Associates
Toledo 6, Ohio

Interesting and Clear

Sir:

We have just read the article "The Prefab Mushroom" by Henry Unger in the May CONSULTING ENGINEER. This was our first look at a copy of the magazine, which we understand is a new publication.

CONSULTING ENGINEER is pleasing to read; the presentation of its editorial content is interesting and clear, and we greatly appreciate the mention given Butler Manufacturing Company and Butler steel buildings in Mr. Unger's story.

If, at any time in the future, you need material on the prefabricated steel building industry, we hope you

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Modern plants require the utmost in power distribution efficiency, reliable circuit protection, service continuity, safety, and economy.

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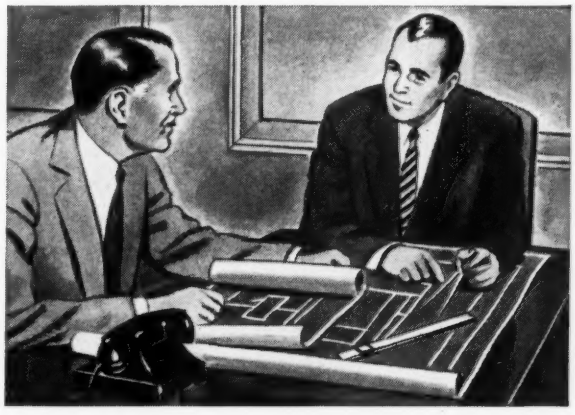
There is an I-T-E Application Engineer near you. He will assist you with your specific requirements—and show you how you can save with *complete* I-T-E engineering. Give him a call. Look in the classified section of your telephone directory under "Electrical Equipment."

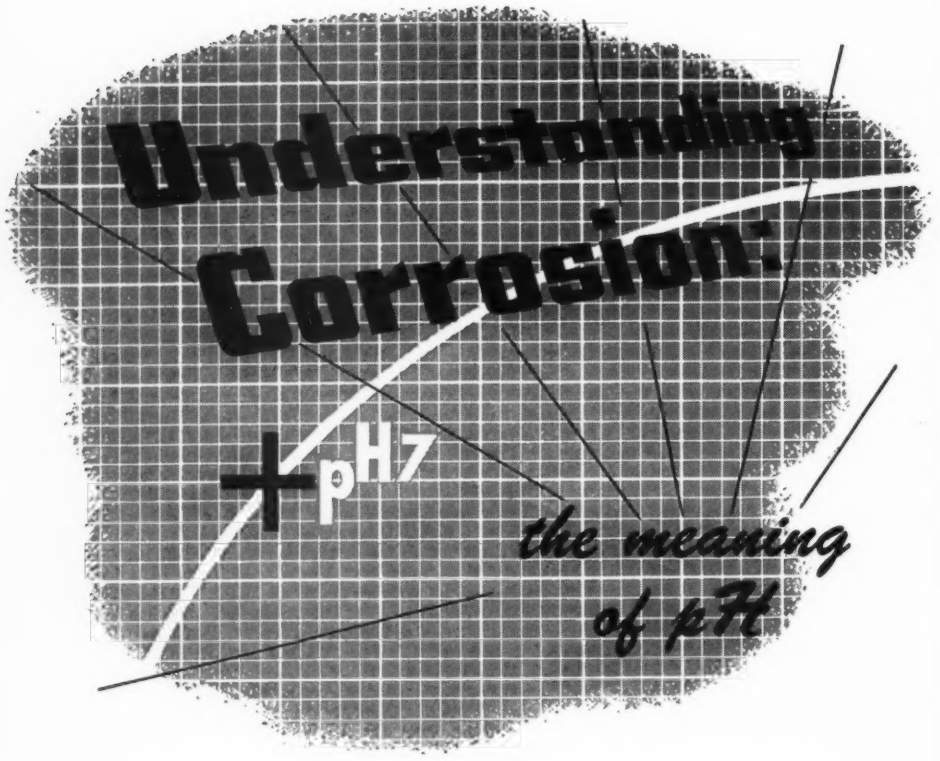
T-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa.



I-T-E

UNIT SUBSTATIONS

for every application



A governing factor in establishing the rate and extent of corrosive attack of a solution on metal is the determinant of acidity or alkalinity — hydrogen-ion activity. This factor is identified by the symbol pH and measured on a scale on which readings of less than pH 7 indicate acidity and more than pH 7, alkalinity. Intensity either of acidity or alkalinity exerts a primary influence on the tendency toward corrosion, with severity of corrosive attack at its greatest in the acid zone and generally decreasing as alkalinity increases. Variations in pH further alter the degree of influence of other factors in corrosion. The nature of corrosion products, for example, may be affected, thus changing the character of the resulting protective film and rendering such a film formed in the neutral or alkaline zone more effective than one formed in the acid zone.

Consideration of pH as it affects and is affected by other determining factors is essential to proper evaluation of any corrosion problem. Understanding and assessing the relative importance of this and of all factors involved is Dampney's first approach to a preventive or corrective program — an approach that forecasts with exceptional accuracy the ultimate success of the coating system selected.

In the production of chemicals, food, petroleum, textiles — wherever power and processing needs create difficult or unusual corrosion problems — you will find Dampney *equipment-engineered* coatings performing most satisfactorily. Whether *your* corrosion problem involves diesel engines or fume-carrying ducts . . . steam turbines or corrosive-handling tanks . . . Dampney knowledge and experience can help you. We invite you to call upon it freely.

MAINTENANCE FOR METAL

THE DAMPNEY COMPANY

154-1

HYDE PARK, BOSTON 36, MASSACHUSETTS

will give us the opportunity to be of service to you.

David C. Etheridge
Butler Mfg. Company
Kansas City, Mo.

"Fees and Contracts"

Sir:

Enclosed is check for one year subscription. I would like it to start with the March issue if possible.

I repeat many readers' comments that we hope you stick to your primary object in directing this periodical to consulting engineers, as such.

I would like very much to see *one* article a month, by an independent consulting engineer, on practical matters such as fee setting, contracts, and office management.

Robert F. Carter
Consulting Engineer
East Weymouth, Mass.

● SEE "FEES AND CONTRACT TERMS", JUNE, 1953, AND "SUBCONTRACT YOUR DRAFTING," IN THIS ISSUE—ED.

SIR:

DELIGHTED WITH FEES AND CONTRACT ARTICLE. PLEASE RUSH TEN COPIES JUNE ISSUE. PLEASE KEEP TYPE STANDING FOR REPRINT.

HERBERT ASKWITH
THE KULJIAN CORP.
PHILADELPHIA, PA.

Sir:

We would like to obtain a small number of reprints of the article "Selecting Contractors On a Fixed Fee Basis" as published in the May, 1953 issue.

Will you kindly quote us on these.

Langdon Cheves, Vice President
Daniel Construction Co., Inc.
Greenville, South Carolina

Professional Cards

Sir:

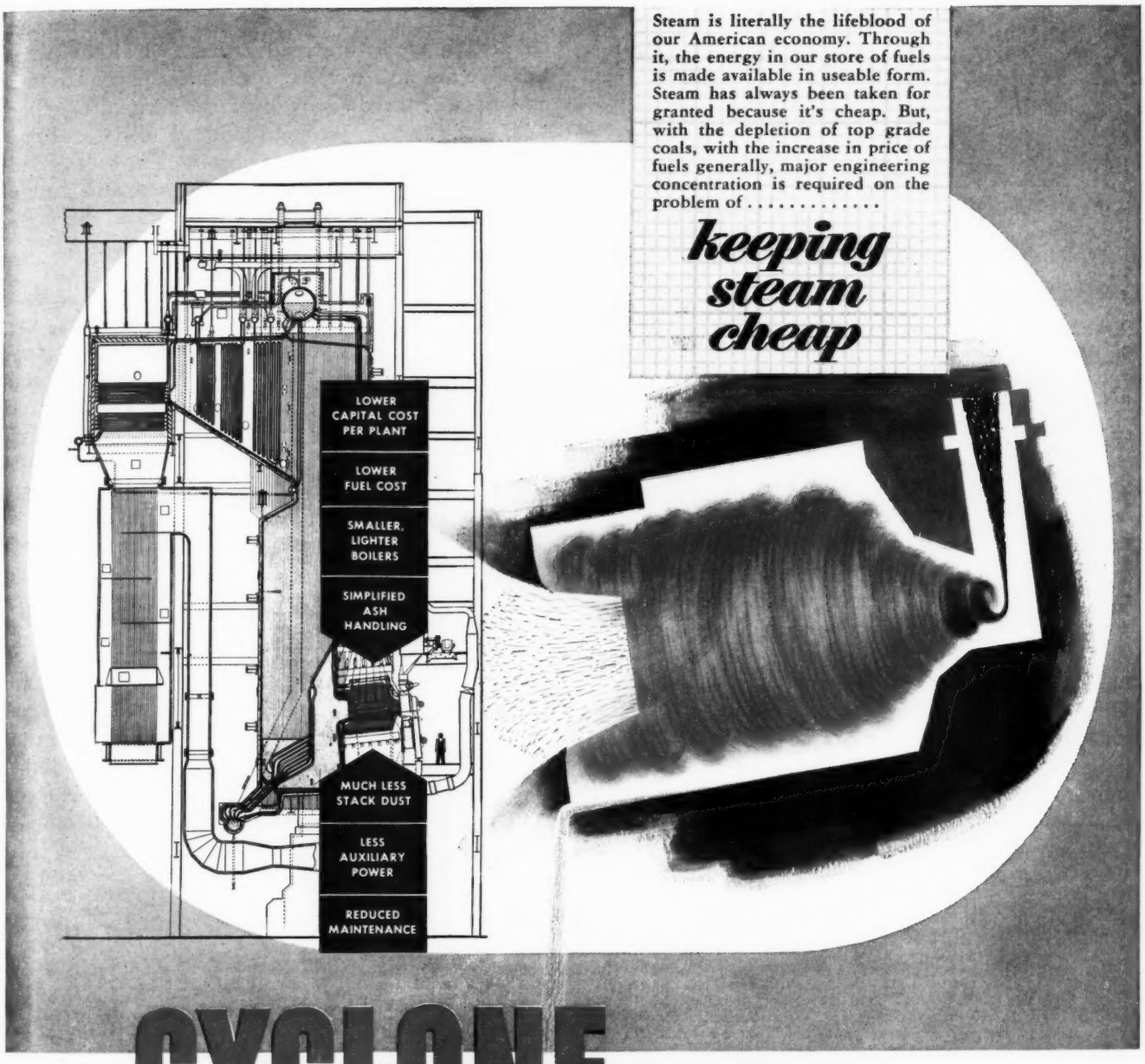
Please carry our Professional Card in CONSULTING ENGINEER magazine for the next year.

We attach hereto copy to be used for the card. You may bill us at Dillsburg for the cost of the year's listing.

May we extend our sincere compliments on the excellence of articles which have been appearing in your magazine.

G. C. Hertweck, Vice President
Capitol Engineering Corp.
Dillsburg, Pa.

● SPACE IS NOW AVAILABLE FOR PUBLICATION OF CONSULTANTS' CARDS IN CE'S PROFESSIONAL DIRECTORY (SEE PAGE 71) THIS PROVIDES A DIGNIFIED, PROFESSIONAL MEANS FOR LISTING YOUR NAME AND SPECIALTY—ED.



Steam is literally the lifeblood of our American economy. Through it, the energy in our store of fuels is made available in useable form. Steam has always been taken for granted because it's cheap. But, with the depletion of top grade coals, with the increase in price of fuels generally, major engineering concentration is required on the problem of . . . . . .

keeping steam cheap

B&W CYCLONE FURNACE

A prominent Eastern utility engineering executive calls the B&W Cyclone Furnace the most important development in the power plant field in the last 30 years. . . . Another well-known utility executive ranks it with the steam turbine. We, in B&W, regard the Cyclone Furnace as one of our most important contributions to power plant engineering progress.

The Cyclone Furnace is important because it has simplified fuel-burning problems, and permitted efficient, economical use of a wide range of coals. More than a dozen different kinds of coal already have proved eminently satisfactory in service, and many more grades are showing promise under test.

Already, B&W's revolutionary method of coal-firing has been selected for a total of 32 boilers with aggregate steam capacity of more than twenty million pounds per hour . . . sufficient to serve over two million kw of new electric generating capacity.

Keeping steam cheap . . . for public utilities and industrial users . . . is a prime engineering objective at B&W. The Cyclone Furnace is one of many B&W cost-saving advantages worth investigating.

BABCOCK & WILCOX
BOILER DIVISION

N-156

SCRAPS & SHAVINGS

TEMPTATION came our way this month, but we resisted. American Cyanamid Co. held a press party to demonstrate new paper products including paper bathing suits and paper raincoats. They passed out a photograph of a pretty girl splashing in the water wearing a bathing suit made of melamine-treated paper. It was reported that the suit withstood the ravage of the waves, and the young lady walked unblushingly from the surf. A surprisingly large number of magazines not connected in any way with the bathing suit trade carried this photograph, and we, indeed, were tempted. Studying the press releases further, we discovered that for this type of paper the test was hardly worth all the photographic film used. Melamine-treated paper will withstand much more than a mere ducking or a casual dip such as a beachwear model might subject it to. Used as a freezer pack, it has been boiled for 72 hours without disintegrating. Such a rugged bathing suit material is no more interesting than the old textile type. Our readers deserve better than this. We are now working on another paper bathing suit made of three layers of newsprint held together with office staples. We are sending a model and our photographer into Lake Michigan next week, and we feel sure we will have a much more interesting presentation than if we had succumbed to the pressure of the American Cyanamid press agents.

AN EXPERT IN DOUBLE-CROSS is Robert Smith-Johannsen, now an employee of the General Electric Chemical Laboratory at Waterford, N. Y. The way GE tells it, Smith-Johannsen was involved in experimental study of ski waxes for an insurance company during the Nazi invasion of Norway, in 1940. He developed a formula for a sticky uphill wax so excellent that the German army ordered 40,000 cases to help their ski troops transport heavy equipment over mountains. They had not reckoned with Smith-Johannsen. Having had enough of Nazi occupation, S-J took off for Sweden, shipping slippery rather than sticky wax to his military customers. In Stockholm he was greeted by newspaper headlines of Nazi ski troopers "backsliding" all over Norway. We only hope that this type of thing is not habit forming. We can imagine the consternation at Waterford if all the bottles marked "H_2SO_4" contained ammonia.

NEW TYPE WATER FILTER . . . for industrial plant water, municipal water supply and swimming pools

The SPARKLER Model SCJ *Diatomite* self cleaning filter

—combines the uniform consistant quality of diatomite filtering with a quick cleaning system of jet spray wash off of plates and backwash.

The filtering element is composed of orlon cloth covered screen discs that readily take an even pre-coat of diatomite circulated from a slurry tank.

The filter cake can be quickly and completely washed off with a built-in jet spray and the filter cleaned by backwash with a minimum of backwash water and plates recoated ready to resume service within a total cleaning time of 10 to 15 minutes.

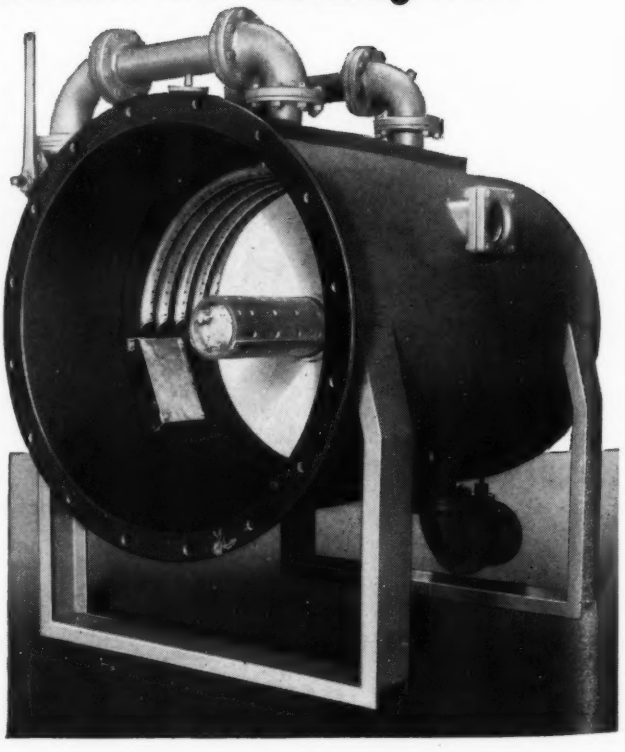
For the first time, in this new development, Sparkler Engineers have successfully combined the desirable features of diatomite filtering and fast self cleaning, without bridging or loss of filtering surface and with the use of very little filtered water at a low flow rate. The distinctive advantages of this type of filter are:

1. Removal of 80% to 100% of bacteria depending on the type of bacteria and the grade of diatomite used in addition to all suspended matter either colloidal or solid. Thus the required chlorination is reduced materially.
2. First cost of a SCJ filter installation is about half that of a sand filter of equal flow capacity.
3. Floor space required for a Sparkler Model SCJ filter is much less than usually anticipated when compared with some other types of filters. The large size SCJ filter with a capacity of 96,000 G.P.H. requires a floor space of only 97" x 77" with overall height of 84".
4. Operation is simple and can easily be handled by any plant mechanic.

Standard single SCJ filter units available in capacities up to 96,000 G.P.H. Multiple units can be used for larger requirements. Also, larger single units can be custom built when desired.

Personal supervision of each installation is made by a Sparkler engineer.

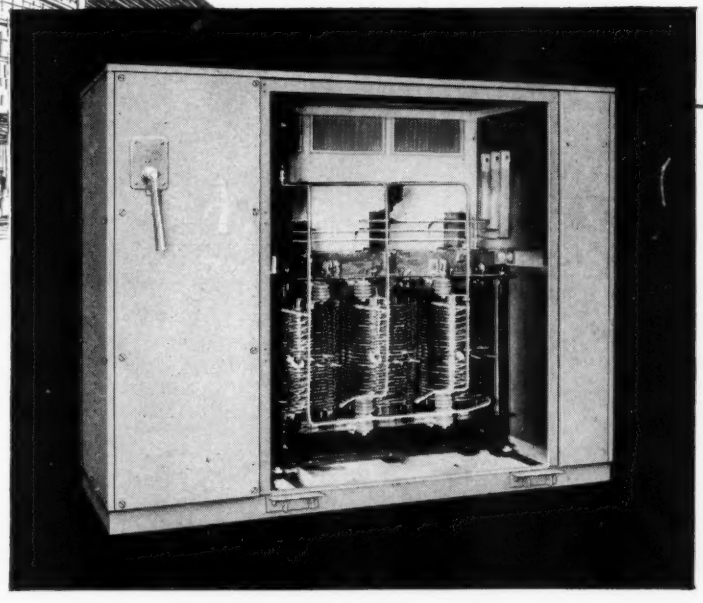
WRITE MR. DAN D. BALDWIN FOR PLANS AND PRICES ON YOUR REQUIREMENTS



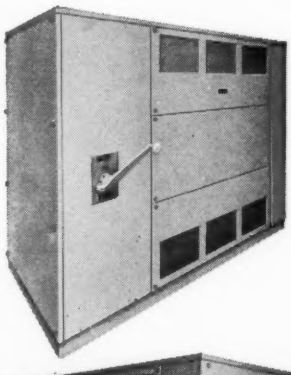
SPARKLER MANUFACTURING CO., Mundelein, Ill.

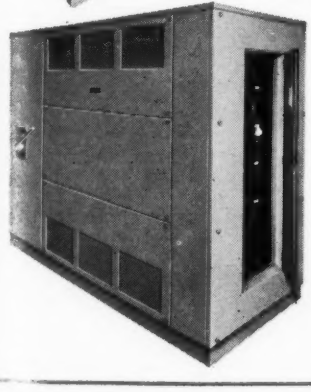
MAKERS OF FINE FILTERING EQUIPMENT FOR INDUSTRIAL USE FOR OVER A QUARTER OF A CENTURY.

FAMOUS-BARR— St. Louis installs NOARK Power Centers



New Southtown Store of Famous-Barr, St. Louis, Missouri, operated by the nationally known May Department Stores Company. This modern merchandising center contains 286,000 square feet and is served by eight Federal-Noark 300 KVA Power Centers. P. John Hoener and Associates, Architects; John D. Falvey, Engineer; Westlake Construction Company, General Contractor; S. C. Sachs Company, Inc., Electrical Contractors.





Just as modern architectural design has come to anticipate today's requirements—and even tomorrow's—so has today's concept of electrical planning advanced. Distribution systems employing Federal Noark Power Centers provide the answer to today's problems and are easily adapted to tomorrow's changing needs.

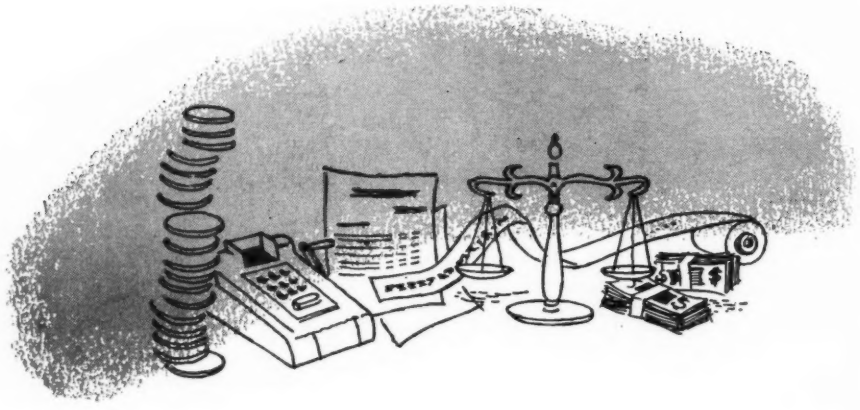
Federal Noark Power Centers are "Tailored" to load requirements from standard, flexible components... "Packaged" for lowest installation costs... "Designed" for efficient operation... "Engineered" for minimum maintenance... "Adaptable" to changing or increased load requirements. Federal Noark Power Centers can be the answer to your distribution problems.

When designing a new building or remodeling an existing one, consult your nearest Federal Noark sales office for information on modern equipment for modern electrical distribution; or write Federal Electric Products Company, 50 Paris Street, Newark 5, New Jersey.

Federal Noark products: Stab-lok Circuit Breakers, Motor Controls, Safety Switches, Service Equipment, Industrial Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct ★ Sales offices in principal cities.

FEDERAL NOARK®

ECONOMIC NEWS NOTES



E. F. Mac Donald
INDUSTRIAL ECONOMIST

LOOK AWAY, LOOK AWAY. Over 3,000 new multi-million dollar manufacturing plants will be built in the South in the next decade. This is the optimistic prediction of Mr. H. McK. Conway, Director of the Southern Association of Science and Industry. The June meeting of the Southeastern Institute for Chamber of Commerce Executives and Staff Members was told further that continued expansion of manufacturing activity would raise per capita income in the South to the national average, require 10,000 additional professional scientists, and give rise to the construction of 200 major plants to produce new products.

SLOW TRACK. Uncertainty regarding business prospects is the principal reason railroads are not placing orders for new equipment, according to representatives at a series of railroad industry meetings late last month. Another factor in the slow-down of capital equipment outlays is the question of whether the ICC will continue the 15% freight rate increase now due to expire next February.

MAINLY REPLACEMENT. Almost three-quarters of business outlays for new equipment in 1952, was for replacement rather than for additional productive capacity. In an enlightening article in the June issue of the Survey of Current Business published by the Department of Commerce, it is disclosed that in the decade ended 1952, nearly one-half the equipment purchased was for the purpose of replacing less efficient and less economical assets. While the tentative nature of the conclusions is stressed, it is indicated that an undue expansion of productive capacity has not yet resulted from the record levels of capital spending for plant and equipment since the end of World War II.

HOUSING PREDICTION. Whisked through by Congress to the President at the last moment before current authority in the housing field expired June 30, the bill on the Federal housing program authorizes the President to reduce down-payment requirements and extend the maturity of such mortgages. The bill provides also an additional $1.5 billion to FHA for mortgage insurance on new private homes, authorizes "Fannie Mae" to revolve its mortgage fund under the "one-for-one" plan, and liberalizes mortgage requirements on rental type FHA housing to increase construction of larger family units. Senator Capehart predicted that the bill would have the effect of "loosening the tight market situation with which the home building industry has been plagued," and help "maintain a reasonably high level of construction throughout the next year."

OPTIMISM. Fears of recession are conspicuous by their absence in the latest survey by the Edison Electric Institute. According to this review of utility company capital projects, the nation's power systems plan to install nearly 14 million kilowatts of generating capacity this year at a cost of about $4 billion, boosting present capacity by about 17%. Plans are being laid to spend over $12 billion in the four years through 1956 to expand capacity to about 125 million kilowatts. This would be 50% greater than present plan and almost two-and-a-half times capacity at the close of World War II.

PESSIMISM. William J. Levitt, possibly the biggest home builder in the country, told the Senate Banking Committee recently that next year he planned to build only 50% of the houses he is putting up this year. He described the current residential building situation as being "on the skids," adding, "It's already too late for lower down payments. They should have gone into effect three or four months ago."

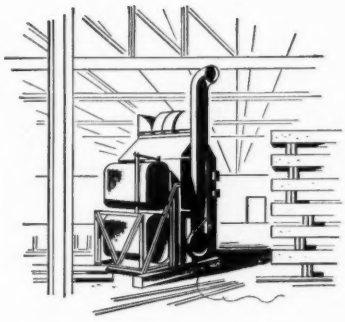
"COULD BE." "It is time for both businessmen and educators to put an end to the reckless overexpansion in the field of engineering education." So warns Mr. Roger W. Bacon. He predicts, "In just a few years many of these hopeful engineering students may well become mere technicians simply because the supply will far outrun the demand . . . the demand for engineers is coming perilously near the saturation point."

IN PASSING. Physicists and engineers already know how to build an atomic reactor producing power on a competitive basis, Dr. I. Rabi, chairman of the advisory committee to AEC, told Congress recently. He holds that the way should be cleared immediately to permit development of nuclear power facilities by private industry . . . **The Munitions Board,** which expired June 30, warned Congress that the armed services are in urgent need of a law providing for rapid expansion of productive capacity and stockpiling of machine tools. Laws on these two points expired June 30 . . . **Republic Steel** is the first large steel maker to add plastic pipe to its product line . . . **$25,000 winner** of General Motors highway contest, New York's Robert Moses, holds that it would cost $50 billion to modernize our highways. He recommends a 10-year program of annual outlays of $5 billion, almost double present rate of highway spending . . . **The General Services Administration** is compiling a list of firms ineligible for Federal contracts because of bad records on past jobs. The blacklist of "companies non grata" is expected to be ready this Fall.

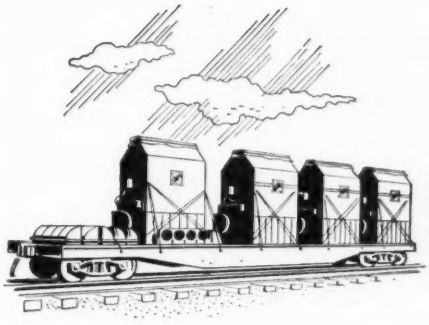
These 12 DRAVO *Counterflo* SPACE HEATERS really got around!

Here's where the Dravo Heater's rugged construction and durability paid off for Ford Motor Company.

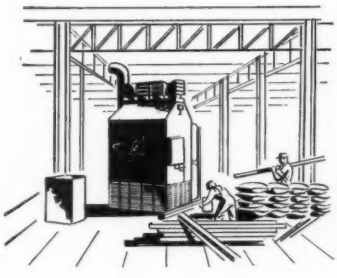
Back in the fall of 1950, Ford purchased 12 Dravo Heaters for temporary heating at Cleveland, Ohio, while Ford's new engine plant was under construction during the winter of 1950-1951.



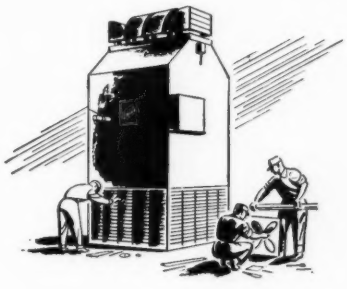
1 The heaters maintained comfortable working conditions and kept the ground from freezing during zero weather so that concrete could be poured.



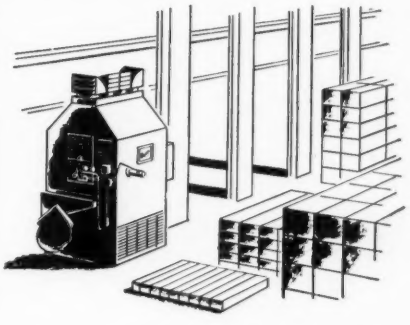
2 After this new plant was completed, four heaters were shipped to Canada and were permanently installed in Ford's warehouse at Winnipeg.



3 The other eight heaters were shipped to Kansas City, Mo., for use as temporary heaters during the construction of facilities similar to those in Cleveland.



4 When that job was finished, the eight heaters were returned to Dravo at Neville Island, Pittsburgh, for overhauling and reconditioning by highly-skilled Dravo personnel.



5 Now these eight Dravo *Counterflo* Heaters have been permanently installed for comfort heating at Ford's assembly plant at Buffalo, New York.

Only Dravo *Counterflo* Space Heaters could stand up under such extraordinary treatment and frequent moving. Dravo Heaters are a product of top-flight engineering and planning; their mill-type, heavy construction means long life, low maintenance and years of satisfactory service.

Dravo Heaters, backed by over 60 years of engineering experience, are available now in a range of sizes from 400,000 to 2,000,000 Btu. Find out how these superior Dravo Heaters can benefit you. Write for more information. Use the coupon.

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Send me information about heating for the subjects I've checked, and Dravo Heater Catalog PQ 523-132

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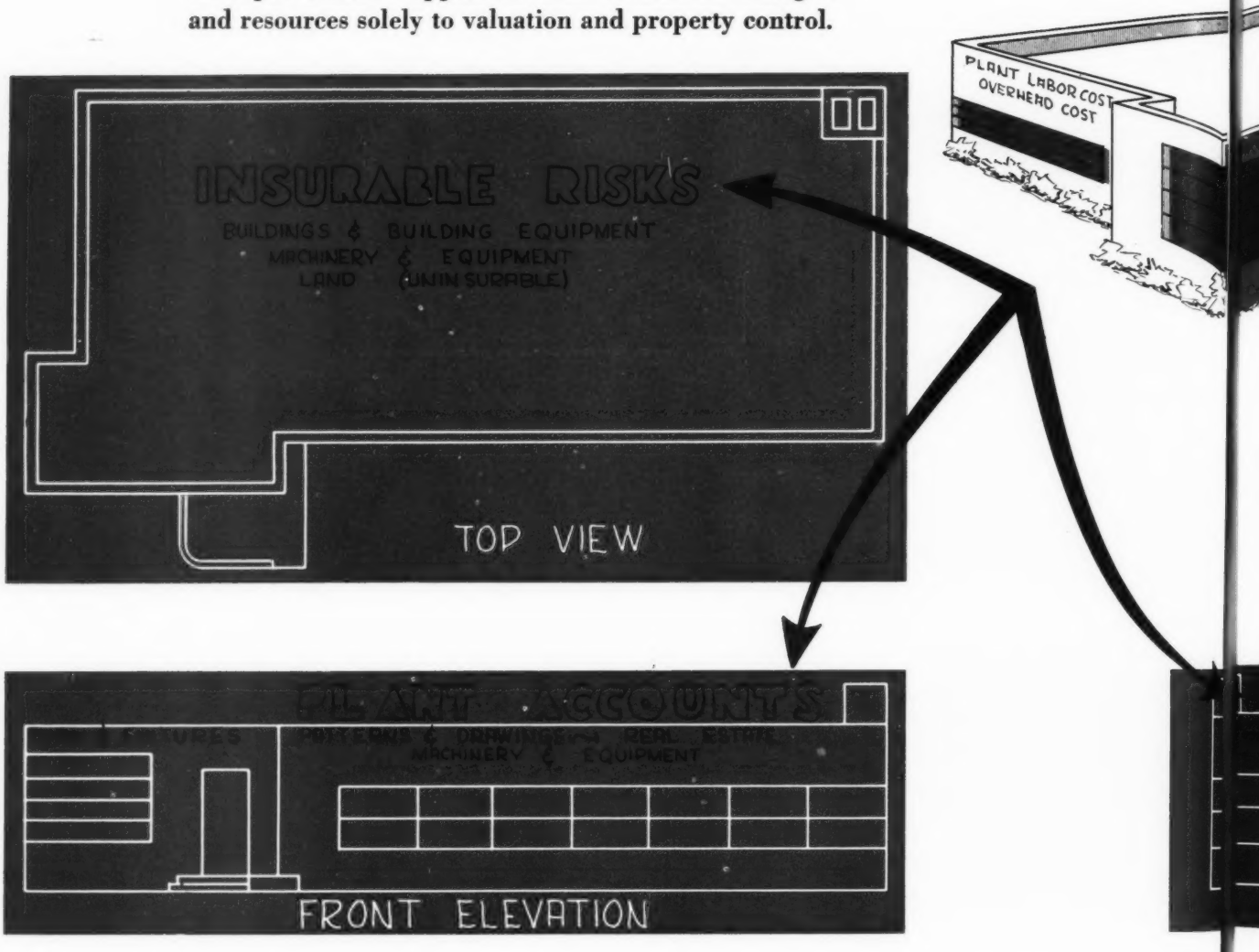
The professional appraisal firm devotes its energies and resources solely to valuation and property control.



When Do Your Clients Need A

C. J. SCHWINGLE,

First Vice President

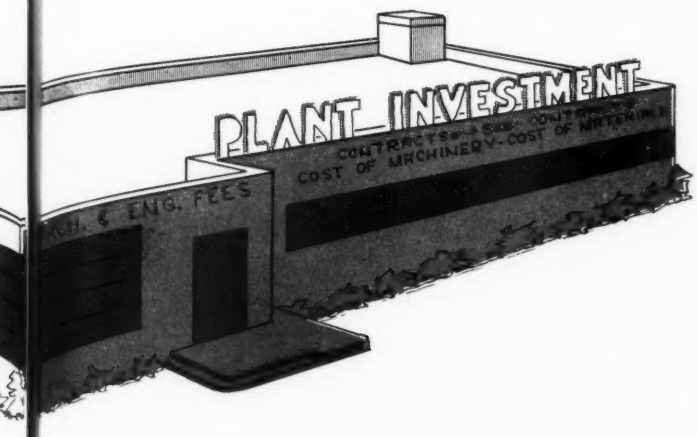
The American Appraisal Company

Mr. C. J. Schwingle, first vice president and director of The American Appraisal Company, joined the Company's field staff about thirty years ago and has been a consultant to large corporations on depreciation and property problems for the past fifteen years. He was educated at Loras College, Dubuque, Iowa, and Marquette University, Milwaukee, Wisconsin. He is a Registered Professional Engineer of the State of Wisconsin.

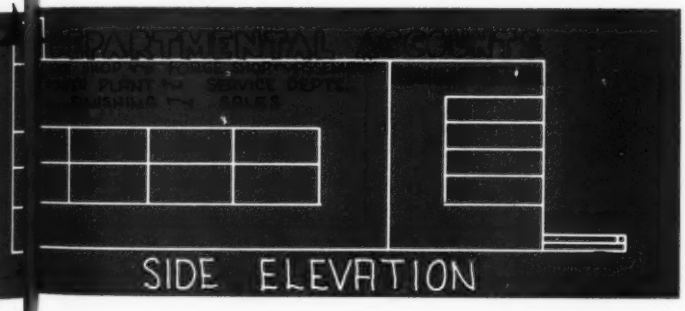
CONSULTING ENGINEERS frequently encounter situations where the need for professional appraisal service is clearly indicated. Some engineering firms may feel that they are adequately supplied with trained personnel, cost records, and statistical data to handle these appraisal problems for their clients. Others may not be equipped to handle specialized valuation problems or, if so equipped, may prefer to delegate appraisal matters to an independent organization engaged solely in that work.

As modern industrial growth has generated the need for specialization in consultation on other engineering matters, so it has impelled the growth and development of professional service devoted to valuation and property control.

The appraisal field requires not merely a knowledge of construction and equipment costs but frequently involves a knowledge of a host of other sub-



THE APPRAISER, LIKE A GOOD DRAFTSMAN, SEES AN INDUSTRIAL PLANT FROM THREE DIFFERENT POINTS OF VIEW. HE TAKES THE TOTAL PLANT INVESTMENT AND BREAKS DOWN ALL ASSETS INTO THREE CLASSIFICATIONS: INSURABLE RISKS, PLANT ACCOUNTS, AND DEPARTMENTAL ACCOUNTS.



d Appraisals?

jects such as property economics, insurance, depreciation, property control methods for income tax and accounting purposes, normal or remaining life studies of depreciable assets, fair market value as distinguished from physical or replacement value, differentiation of depreciation for insurance purposes as distinguished from depreciation for accounting or income tax purposes, and the application of these subjects to industrial plant construction, modernization, and relocation.

For these and other reasons, the consulting engineer may frequently refer his clients to a professional appraisal organization which he feels that by reason of its reputation and experience is particularly well qualified to serve their specific needs.

Often the problem is one which involves not merely the determination of over-all values but the allocation of those values to specific units of property. This is especially true in the case of appraisals prepared for insurance purposes. An estimate of total values may be helpful in determining the amount of insurance coverage required, but it is of little assistance in preparing a proof of loss in the event of fire or other casualty, as the insured is required to furnish an inventory of the property items destroyed or damaged setting forth the value of each item at the date of the loss.

The value of an independent detailed appraisal for insurance purposes has been clearly demonstrated and is widely recognized. Many companies retain an independent perpetual appraisal service to make sure that they will be properly covered at all times and that whenever a loss occurs they will be prepared to effect a speedy and equitable settlement on the basis of an up-to-date authoritative inventory and valuation.

However, appraisal service is by no means limited to insurance needs—important as that is in the current period of inflated values. Problems of valuation are continually plaguing management, and the consulting engineer should be alert to suggest solutions.

Company executives are called upon daily to make important management decisions regarding their property representing a value of perhaps several million dollars. The problems may embrace considerations of tax, plant expansion, insurance protection, or plant modernization; yet such decisions are frequently made without the assistance of a complete physical property inventory valued on a current replacement basis.

There are some interesting special situations requiring appraisals, and the consulting engineer should be familiar with them.

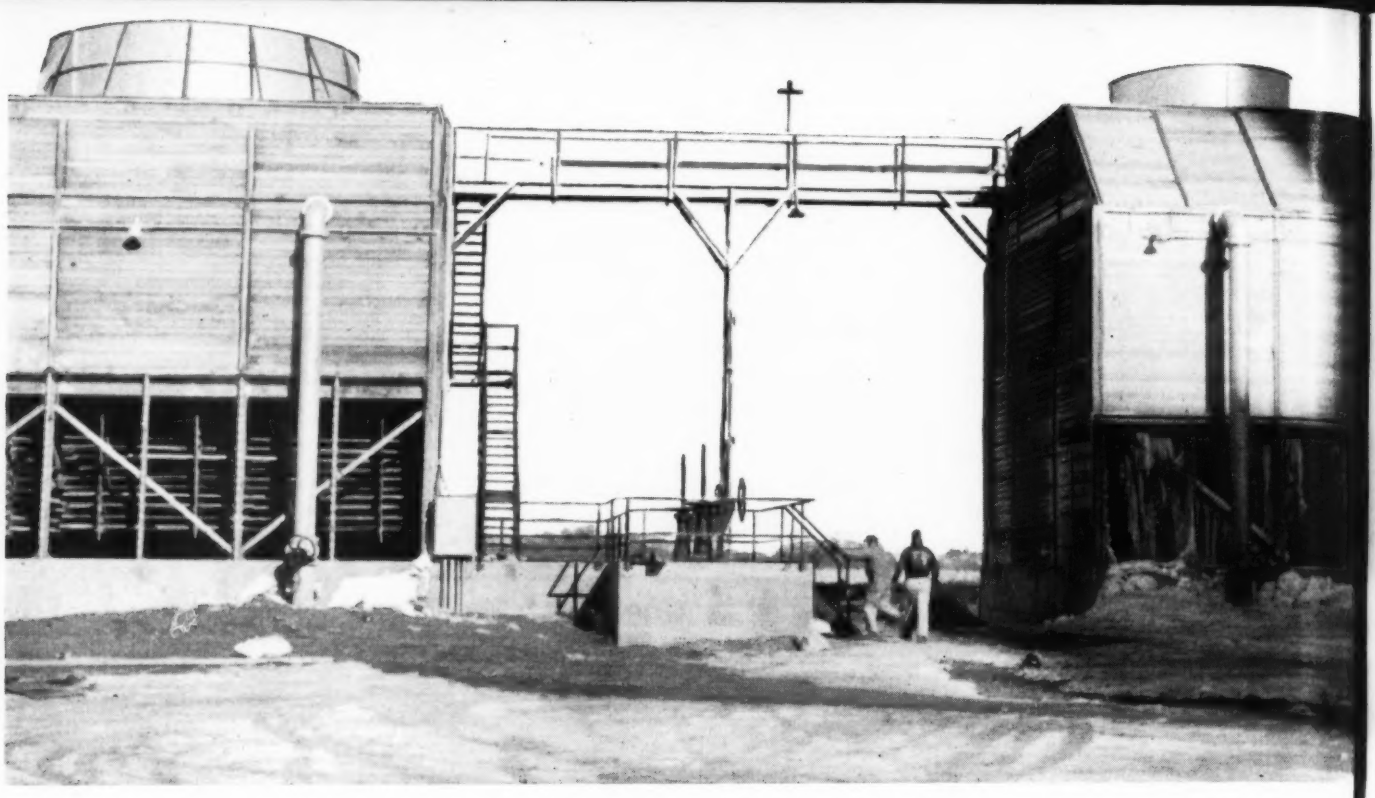
The New Plant

Your client has just completed a new plant which you have designed and seen through to completion. It represents the last work in efficiency. He knows the cost. What need has he for appraisal service?

For income tax and accounting purposes there can be no doubt that cost is cost, and that cost is likewise the basis for setting up his property accounts. He will operate this plant for thirty, forty, or possibly fifty years or more. He expects to recover his investment through annual depreciation deductions. To make reasonably sure of accomplishing this, he will need an adequate property record with realistic estimates of the probable useful life of the various units or classifications of property. He needs to have his costs broken down for each controllable unit of property—each building, each machine.

Although his plant is new and modern in every respect, it cannot be assumed that it will remain unchanged. Through the years replacements and improvements will inevitably be made. For accounting and administrative purposes, these changes will need

(Continued on page 60)



THIS PHOTOGRAPH ILLUSTRATES THE ARRANGEMENT OF A TYPICAL MULTIPLE UNIT COOLING TOWER INSTALLATION.

An Engineering Approach to

Cooling Tower Specifications

H. RAYMOND BAKER, Jr., District Sales Manager
Degree Corporation, Houston, Texas

H. Raymond Baker, Jr., District Sales Manager, Degree Corporation, Houston, Texas, is a mechanical engineer and a graduate of Drexel Institute of Technology. During the war, he served as engineering officer in charge of a diesel engine repair and machine shop aboard a Landing Shop Dock. He taught diesel engineering at Cornell University for two years and has served as a company delegate to the Cooling Tower Institute. He was vice-president of that Institute in 1952 and is also a member of the American Society of Mechanical Engineers. He was until recently, with the C. H. Wheeler Mfg. Co.

Mr. Baker has written a number of technical bulletins and articles, and is thoroughly familiar with the subject of cooling tower specifications and performance.

THE COOLING TOWER INDUSTRY feels growing pains. Propelled to national prominence by ever-increasing water requirements, the industry has expanded rapidly to carry the load. But rapid expansion brings problems not entirely foreseen, and it brings misunderstandings among the manufacturers, the users, and the consulting engineers.

Other industries have passed through similar stages to reach a more sensible plane. For example, consider the present status of the condenser industry. When steam condensers are built, the tube surfaces are new, clean, and bright. Heat transfer coefficient is high, vacuum is good, and steam rate is low.

But good design does not assume such an ideal condition. Good design recognizes that tube scaling or fouling is an important factor in condenser performance. Such fouling is a factor beyond the control of the manufacturer. Consulting engineers do not write specifications which lay this problem at the designer-manufacturer's door. They recognize the condition and write specifications which give proper consideration to the condition of the available circulating water.

Designers, consulting engineers, and users have become persuaded that "fouling factor" or "cleanliness factor" has a proper place in condenser specifi-

cations. Eighty-five percent clean is a figure frequently used for ¾ in. and larger diameter tubes. This means that the design heat transfer coefficient is 85 percent of the value which the condenser has when tubes are clean. Such practice in writing specifications has been adopted almost universally.

Prior to the investigations of the effects of tube fouling, many condenser designer-manufacturers were in trouble performance-wise. Specifications did not recognize fouling, and competition did not permit making allowances. The manufacturer who held to the line in design could easily underbid the manufacturer who recognized and allowed for the fouling problem. Thus, a condenser purchased on the basis of the low bid normally would only meet the performance specifications for a very short time. As soon as fouling started, vacuum suffered, steam rate increased, and plant economy dropped.

Performance vs Specifications

Many cooling tower users and their engineers have confidently specified exact design conditions only to be rudely awakened. For example, one project required 85 F water when the ambient wet bulb temperature was 75 F, but the unit produced a minimum water temperature of only 87 F, and usually it was higher. Both engineer and user rushed to the conclusion that the designer-manufacturer had short changed them. "He didn't meet his guarantee," they said. But the manufacturer had offered a unit which his design data, from other similar installations, indicated would work perfectly well.

Wet bulb temperature measurements were taken at the air inlet louvers and 50 to 100 feet upwind from them with varying wind conditions. These test readings indicated that recirculation of the air leaving the tower and re-entering the inlet louvers was robbing the tower of its capacity. The entering wet bulb temperature was being raised artificially, sometimes as much as several degrees, by recirculation.

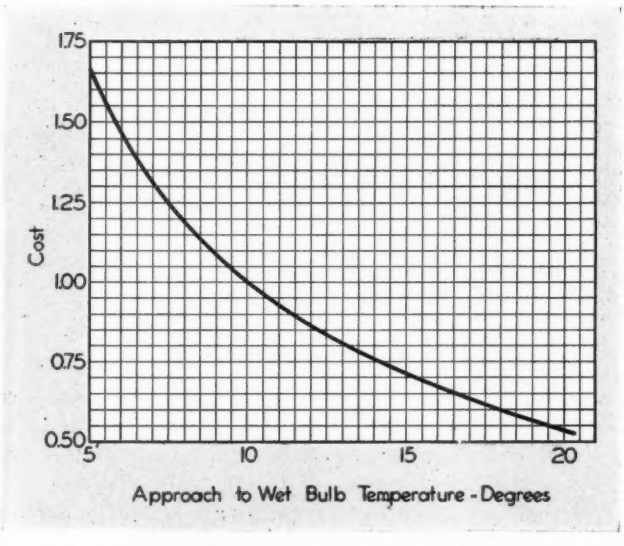


FIG. 1—COST VARIATIONS WITH APPROACH TO WBT.

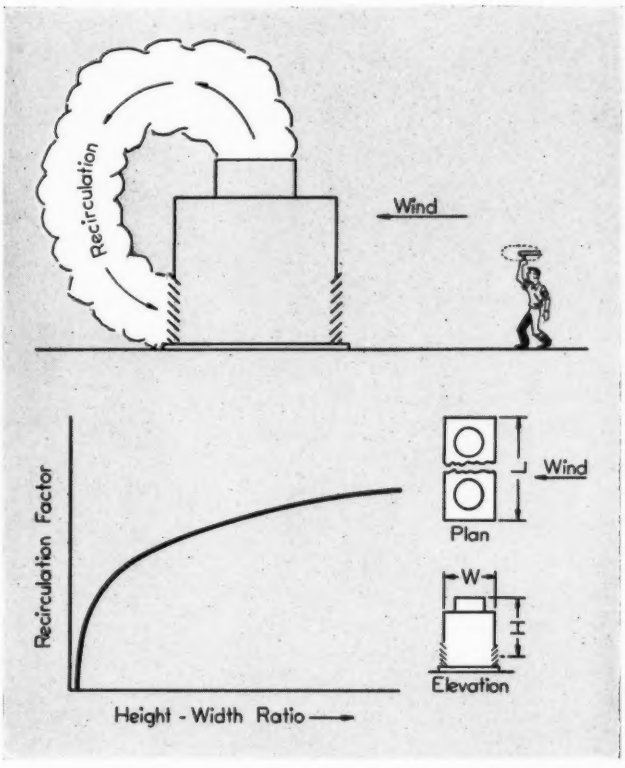


FIG. 2 (TOP)—METHOD FOR MEASURING AMBIENT WBT.

FIG. 3 (BOTTOM)—TOWER RECIRCULATION FACTORS.

Many engineers have recognized and tried to eliminate this problem. Certain "get tough" policies have been established including the attitude that the designer-manufacturer must rule the winds. Specifications have stated that the designer-manufacturer must add cells including foundation, wiring, piping, and all other related items at his own expense if the tower falls short of specified performance. Yet consider, for example, a cooling tower designed for these common conditions: 95 F entering water temperature, 85 F leaving water temperature, and 80 F ambient wet bulb temperature. It is quite possible for such a tower to have its entering wet bulb temperature artificially raised as much as 5 F as a result of recirculation caused by peculiar wind conditions. How then would any designer meet his guarantee of 85 F water when the entering wet bulb temperature also is 85 F?

The result of "get tough" specifications is to force the bidders to make certain allowances. The more exacting the specifications, the greater will be the allowances and the more money it will cost the user. However, each designer's allowances will be different, and other things being equal, the contract will go to the bidder taking the biggest gamble. To illus-

trate, suppose an approach (difference between leaving water temperature and wet bulb temperature) of 10 F is desired. If one manufacturer allows 2 F less approach as his "factor of safety for recirculation," he increases his tower price by approximately twenty percent, as shown in Fig. 1. If he figures in 3 F less approach, he increases the tower size and price by about 30 percent.

Factors Influencing Recirculation

Recirculation is not a simple problem. In addition to the affect of wind conditions, it is also influenced by the following factors:

1. Height—width ratio of tower.
2. Height—length ratio of tower.
3. Relative height and orientation of tower with respect to adjacent buildings.
4. Proximity of adjacent buildings.
5. Densities of air entering and leaving tower.
6. Velocities of air entering and leaving tower.
7. Tower design (counter flow or cross flow).
8. Orientation of tower with respect to prevailing wind conditions during high wet bulb temperature periods.
9. Location and value of external heat sources.

In general, a tall tower has less chance for recirculation than a short stubby one, and induced draft designs are better than forced draft designs. But identical towers will have different amounts of recirculation under different installation conditions.

Need for Standards

There is need for a set of standards which specify a "recirculation factor." One method would be to apply a correction to the ambient wet bulb temperature to arrive at a design entering wet bulb temperature. The manufacturer would then design for the same water temperatures but at a higher than ambient wet bulb temperature. For example, if a tower is to cool water from 100 F to 85 F with 70 F ambient wet bulb temperature the actual specifications could list 71.5 F entering wet bulb temperature. This corrected figure would be determined from the established standards.

It would be the duty of the user or his engineer to include in the specifications a map showing the proposed locations of the tower and adjacent buildings as well as prevailing wind direction during peak wet bulb temperature periods. Building heights should also be given. Then, as the designer-manufacturer prepares his estimate, he can weigh the project restrictions and specify what recirculation factor was used in establishing the contract price.

Tower performance (or acceptance) testing then would be arranged to eliminate recirculation as a factor by determining entering[1] instead of ambient[2] wet bulb temperature. This method would have the advantage of putting all bidders on the same basis so the user could accurately select the proper tower.

The complexity of the factors which influence performance will undoubtedly make establishment of standards difficult. However, a start can be made by first considering only tower dimensions and relative wind direction. Fig. 3 shows a possible relationship between height-width ratio and recirculation factor. The height of the tower is from the midpoint of the air inlet to the top of the fan hood, and the width is from one air inlet to the opposite one. In this case, the direction of wind is broadside to the tower.

Recirculation factors vary from 1.0 with tall towers to lower values with short, stubby towers. They are applied to the approach to the wet bulb temperature, which for a desired condition of 90 F cooling water with 78 F ambient wet bulb temperature would be 12 F. If reference to Fig. 3 indicates a recirculation factor of 0.833, the approach to be used would be 0.833 x 12 or 10 F. Thus, the specifications would list a design entering wet bulb temperature of 90 minus 80, or 10 F.

In selecting a cooling tower, the designer-manufacturer first determines approximate dimensions and then adjusts the design in accordance with the recirculation factor. This applies only to winds broadside to the tower. For winds lengthwise, another set of factors would be used but arranged in a similar fashion. The criterion would be the height-length ratio of the tower.

The Cooling Tower Institute[3] has established a work program to investigate the factors involved in cooling tower recirculation and to publish data obtained, for the benefit of the interested public. In the meantime, it is suggested that users, consulting engineers, and designer-manufacturers pool their existing knowledge so that mutually acceptable and reasonable allowances for recirculation can be made in the specifications. Furthermore, all users of cooling towers who can conveniently obtain reliable entrance and ambient wet bulb temperatures and associated data from existing installations, especially during the warm summer months, should forward all pertinent information to the tower manufacturer or to the Secretary of the Cooling Tower Institute.

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(1) Accurate determination of entering wet bulb temperature involves measurements at many stations along both louvered sides of the tower. Readings are taken as close to the louvers as practicable and, if louvered areas are vertically large, at more than one elevation. Anemometer readings of air velocities at each point indicate the significance to be given each reading. Weighted averages rather than arithmetrical averages reduce the many readings to one true average entering wet bulb temperature.

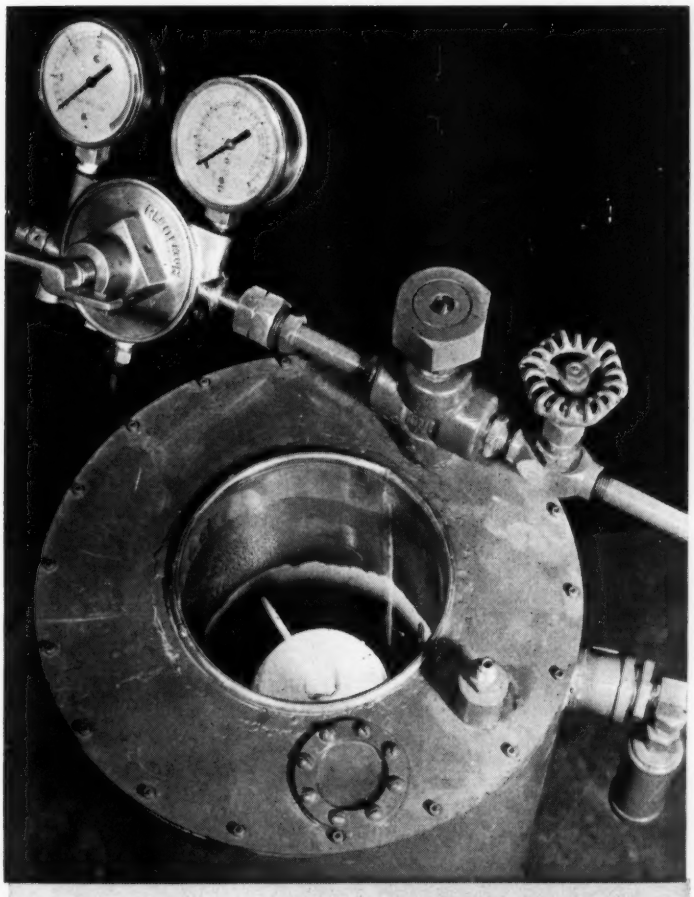
(2) Ambient wet bulb temperature is measured at the maximum practicable distance upwind from the tower (say 100 ft) as shown in Fig. 2. It is measured at several points, especially if the wind is approaching broadside to a long tower. Care must be taken to observe the effect of adjacent buildings to insure that the measuring station is between the tower and any external heat sources which could influence performance.

(3) For further information on the Cooling Tower Institute, contact C. H. Wheeler Manufacturing Company, Cooling Tower Division, 407 South Dearborn Street, Chicago 5, Illinois.

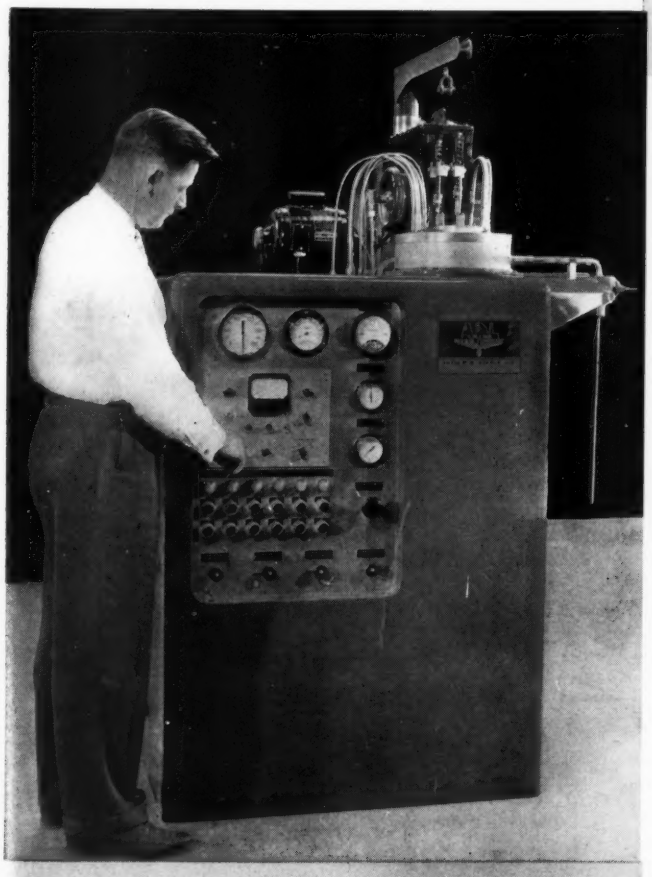
. . . Toward Zero Absolute

FRANK CHARITY

Is it possible to make lead a better electrical conductor than copper? Or use selenium to rectify alternating current? Or de-magnetize magnetic metals? Scientific research, the very low temperature refrigerator, and temperatures approaching absolute zero furnish the answers.



LOOKING INTO METAL CYLINDER IN WHICH LIQUID NITROGEN IS REMOVED FROM PURIFIED HELIUM.



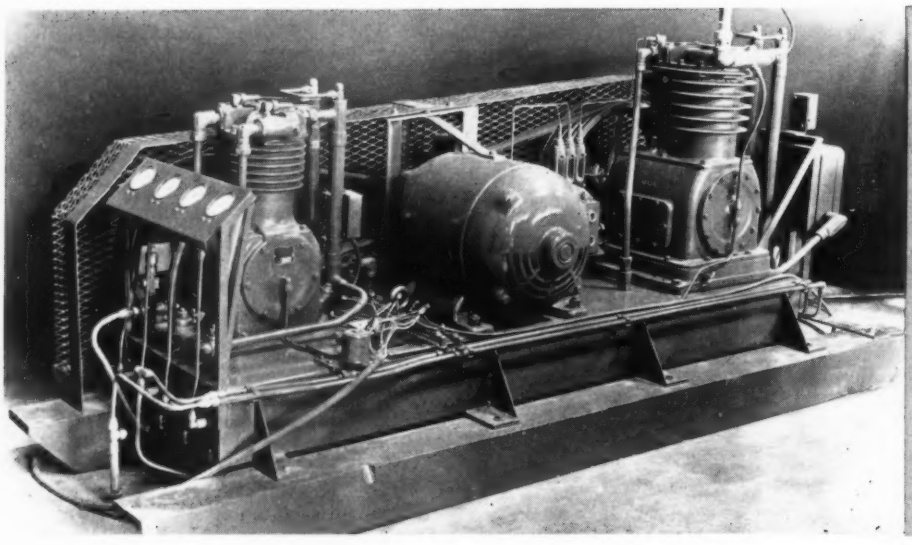
FROM PANELBOARD OPERATOR CONTROLS LIQUIFYING OF HELIUM AT -452 F IN COLLINS' CRYOSTAT.

CRYOGENICS is the science of low-temperature physics. In recent years, research in this field has been largely concerned with phenomena that occur when substances are chilled to approximately absolute zero (or -459.8 F). As yet, there is no cryostat (cryostat is the scientific term for a low temperature refrigerator) that can produce a temperature of absolute zero—the temperature at which all thermal activity ceases to exist—and it is possible that such refrigerator cannot be developed since all refrigeration processes now known require thermal energy. However, a number of cryostats in existence can produce temperatures just a fractional degree higher than absolute zero.

Background

The purpose of refrigeration is to retard or halt what physicists call "thermal chaos" — the heat produced as a result of the rapid movement of electrons and other nuclear particles of any substance at temperatures above absolute zero. Thermal chaos is the basic phenomenon that causes virtually all changes in materials—for example, the corrosion of steel and the spoilage of vegetables.

Accordingly, when a material is chilled so that little or no thermal chaos can take place, a number



A CONVENTIONAL FOUR-STAGE COMPRESSOR WITH A TWO-TO-ONE COMPRESSION RATIO MINIMIZES CONTAMINATION OF THE HELIUM WITH LOW-VAPOR PRESSURE LUBRICANTS.

of strange phenomena can be observed. Poor conductors of electricity, for example, become superconductors at temperatures in the neighborhood of absolute zero.

Initial research in the low-temperature field provided knowledge that paved the way for making artificial ice and the household refrigerator. However, early low-temperature investigators were not as interested in producing cold as they were in determining whether all gases could be liquefied. They began by liquefying ammonia in 1798, and that work subsequently became the basis of the commercial refrigeration industry.

Dry ice, or solid carbon dioxide, which is generally considered a recent development, was first produced in 1835, although no practical use could be found at that time for such a refrigerant. Later efforts to liquefy oxygen, hydrogen, and nitrogen led to the discovery of the principle that permits the construction of modern cryostats—namely, the fact that no amount of pressure will liquefy a gas unless the gas has been cooled to its critical temperature.

Helium Cryostat

Helium is considered the best of the existing low-temperature refrigerants, because it solidifies at a theoretical temperature of absolute zero. Other gases now used as coolants either liquefy or solidify at temperatures ranging from -100 F to -420 F.

Most practical of the helium cryostats is a device invented by Dr. S. C. Collins of Massachusetts Institute of Technology and one of his former students Dr. Howard O. McMahon. It is manufactured by Arthur D. Little, Inc., of Cambridge, Mass.

The purpose of the refrigerant in Collins' cryostat is to cool other substances by absorbing their heat energy after the coolant has undergone compression. But the liquefication of helium is an exceptionally difficult task because Joule-Thompson expansion produces no refrigerative effect (regardless of initial pressure) until the gas has been cooled to -423 F by other means.

In some liquefiers, gases such as nitrogen and hydrogen have been compressed for the purpose of chilling helium to its critical temperature; unfortunately, the apparatus that was required to accomplish this was too costly and cumbersome to be of any practical value beyond the confines of research laboratories and experimental stations.

Operation

Collins' cryostat is considered commercially practical because it eliminates the need for two or more refrigerants and two or more refrigeration installations. Its operation involves the compression of helium, the removal of the heat of compression with tap water, and the thermal isolation of the cold end by gas-to-gas heat exchange. Temperature differentials at intermediate points in the heat-exchange system are produced by isentropic expansion through engines. Liquefaction is finally effected at the cold end by isenthalpic expansion through a needle valve, where the temperature falls below the liquefaction point, approximately -452 F.

A return circuit within the cryostat carries helium that has not been liquefied, or helium that has evaporated, back to the first stage of the compressor. Liquid helium can be removed from the cryostat by means of a draw-off tube.

One of the difficulties in the low-temperature field is compressing a gas without contaminating it with oil vapor or hydrocarbons formed by the slow decomposition of lubricants in the hot compression space of a compressor. In most circumstances, such contamination has been accepted as a necessary evil which could be offset by passing the gas through suitable purifiers following compression; but, where helium is employed as a refrigerant, the use of

purifiers is not possible from a practical viewpoint.

In Collins' cryostat, the contamination problem has been solved by using a conventional air compressor arranged for a two-to-one compression ratio so that compression temperatures are not high enough to vaporize low vapor pressure lubricants. This reduces contamination to such an extent that any entrained droplets can easily be segregated.

Commercial Applications

One of the most unusual uses for ultra-low temperatures at present involves the production of superconductors. This process normally consists of chilling metals such as mercury, tin, lead, aluminum, zinc, and titanium to temperatures within a few degrees above absolute zero, at which time the atoms and molecules of the materials are so close together that they have much less resistance to electrical current than the best of conventional copper conductors presently used.

Of perhaps more importance, is the relatively recent discovery that a considerable number of materials such as columbium nitride can be used like selenium to rectify alternating current, if they are properly chilled with liquid helium.

In many circumstances, materials that have been helium cooled will resume their normal physical characteristics at room temperature. But not always. Some substances such as vulcanized rubber can be cracked and permanently damaged by extremely low temperatures, while other materials such as the nylon fiber can be cold-treated for greatly increased strength at room temperature.

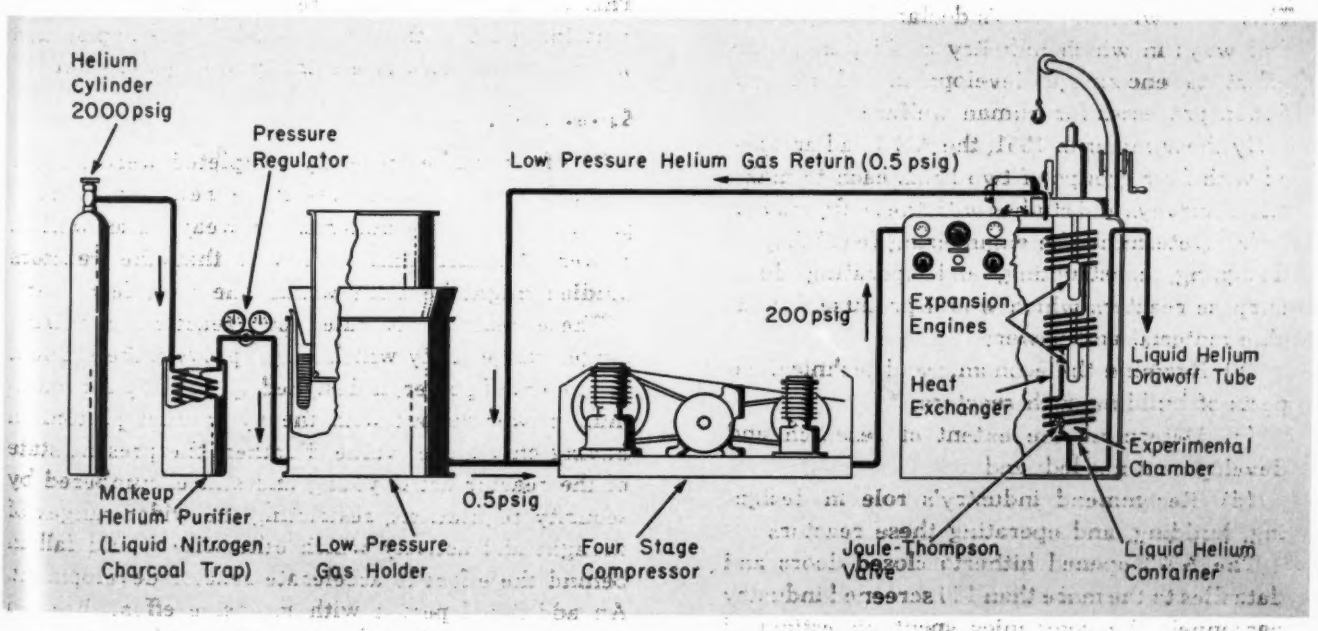
It is also interesting to note that the reactions of some materials to both low and high temperatures are similar, if not identical. Magnetized metals, for example, can be completely demagnetized by refrigeration and can then be used as screens against magnetism or magnetic fields.

Cryogenic research and Collins' helium cryostat are playing a vital role in the current development of atomic energy. It is a fairly well-known fact that hydrogen must be frozen if its particles are to be concentrated enough to be of effective use in making bombs. There seems to be a possibility that helium-chilling will greatly increase the longevity of certain radioactive chemical elements produced by nuclear fission and its reactions.

Many radioisotopes are extremely short-lived because their ruptured atoms rapidly disintegrate into basic energy particles or radiations. Radioactive zinc, for instance, can lose virtually all of its energy in less than two hours. This is undesirable because radioisotopes of all types could serve many practical purposes (in the treatment of cancer, the inspection of industrial products, etc.) if only they could be transported from their nuclear reactors.

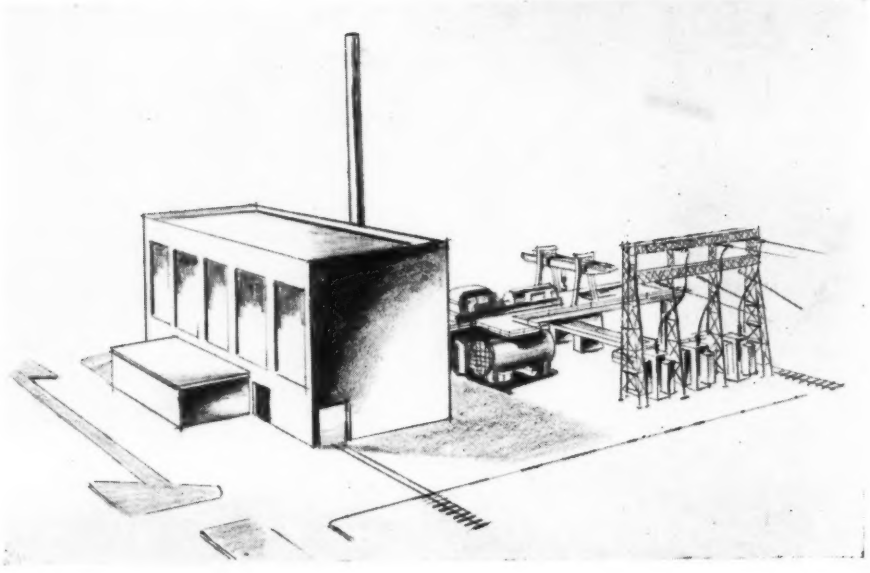
Since radioactivity is closely related to thermal chaos, it is entirely possible that the longevity of radioisotopes could be increased if the latter could be packaged in containers filled with liquid helium. However, the practicability of this concept has not yet been established.

As a refrigerant for the preservation of substances other than radioisotopes, liquid helium has the distinct advantage of being able to retard many chemical reactions more effectively than coolants now available. For instance, highly plastic monomers, which would solidify in a matter of days or weeks in a conventional freezer, can be stored for years.



COLLINS' MACHINE IS A TWO-CYLINDER ENGINE WHICH RUNS ON COMPRESSED HELIUM LETTING THE GAS COOL BY DOING WORK AND RIDDING ITSELF OF ENERGY. COLD EXHAUST GAS FROM ONE CYLINDER COOLS THE OTHER INTAKE.

COMMERCIALLY COMPETITIVE GENERATION OF ELECTRICITY BY ATOMIC POWER WILL BE CHARACTERIZED BY HIGH CAPITAL INVESTMENT AND LOW FUEL COSTS. TRANSLATING THESE COSTS INTO RATES FOR POWER DELIVERED TO THE BUS OF AN ATOMIC STATION (SEE ARTIST CONCEPTION, RIGHT) WILL ULTIMATELY DETERMINE WHEN AND IF PRIVATE CAPITAL WILL UNDERWRITE ANY INVESTMENT IN NUCLEAR POWER.



Industry and Atomic Power

A Staff Report for Consulting Engineers

SOON AFTER the Atomic Energy Commission took over responsibility for the country's atomic program, industry leaders began to propose participation in the atomic energy field by private enterprise financed with private capital. This fitted with the AEC's declared purpose to find ways in which industry could join in the effort to encourage development of nuclear fission processes for human welfare.

By the summer of 1951, the AEC had arranged with four groups of two firms each to make initial surveys and studies with these objectives:

(a) Determine the engineering feasibility of designing, constructing, and operating dual-purpose reactors which would produce fissionable material and power;

(b) Examine the economic and technical aspects of building such reactors;

(c) Determine the extent of research and development needed; and

(d) Recommend industry's role in designing, building, and operating these reactors.

The AEC opened hitherto closed doors and data files to the more than 100 screened industry personnel; the companies spent an estimated million dollars to complete their studies.

By HAL BERGEN
Associate Editor

CONSULTING ENGINEERS will soon find the atomic reactor a device to be reckoned with. This stems from the most recently disclosed studies, containing latest thinking regarding the application of nuclear reactors to electric power generation.

Survey Limits

The four studies recently completed were limited to dual-purpose reactors — those reactors which produce fissionable material for weapons as well as power. Another limitation was that the reactors studied might be built within the next few years.

These restrictions ruled out reactors requiring longer-range study which might prove more efficient producers of power, if designed specifically for maximum power output with the by-product plutonium having only a fuel value. Further, the present state of the reactor art is young and still encumbered by security regulations, restricting the wider ranges of thought and activity which otherwise would fall in behind the effort to accelerate reactor development. An additional period with intensive effort directed toward reactors for power, coupled with more widespread dissemination of latest reactor technology data, would permit increased training of scientific

and engineering talent. In spite of these restrictions, the reactors proposed in the reports of the first four survey teams hold out much interest for the consulting engineer who will soon find himself working in an atomic environment.

Survey Teams

The following firms joined in contributing the manpower and funds to make up the survey teams: Commonwealth Edison Company and Public Service Company of Northern Illinois; Dow Chemical Company and Detroit Edison Company; Monsanto Chemical Company and Union Electric Company; and Pacific Gas and Electric Company and Bechtel Corporation.

All four groups agreed that dual-purpose reactors are technically feasible and can be operated so that the sale of plutonium will bring the cost of the generated power down to competitive levels. However, they also agreed that no reactors currently foreseeable could be built and operated competitively for power generation alone.

The consulting engineer is less concerned with the intricacies of reactor technology than with other vital factors he must reckon with in coming to grips with an atomic reactor he may find supplying steam for a turbogenerator. These factors include revised thinking about plant facilities and arrangement, economics of fissionable versus fossil fuels, radiation hazard protection, and the integration of reactor control apparatus with station controls as a whole.

Typifying the guided apprehension with which those working in the power generation field approach the atomic station, is the problem of steam cycle temperatures and pressures as they may be affected by the atomic reactor steam generator. While it is true that the atomic reactor and high-temperature, high-pressure steam cycles are both the latest word in the power field, it is not necessarily true that one requires the other.

Present thinking indicates conventional steam turbines will be supplied from heat exchangers in turn supplied by the reactor's primary coolant. It is this coolant and the reactor itself which may be unique. It may also be that reactors and their materials will be improved and be made compatible with the more efficient, high-pressure, high-temperature steam turbines. But these things are not necessarily related nor interdependent — the atomic reactor is merely a new source of heat for the same turbogenerators which have been used and will likely continue to be used regardless of the coming atomic age.

The Breeder

The great promise in reactors is the simple word "breeder," for while the restrictions on the four survey teams bound them to older reactors using well established techniques, the atomic program is not standing still. The AEC has recently announced a successful experimental reactor of the breeder type;

COMPARATIVE DATA EXTRACTED FROM SURVEY TEAM REPORTS

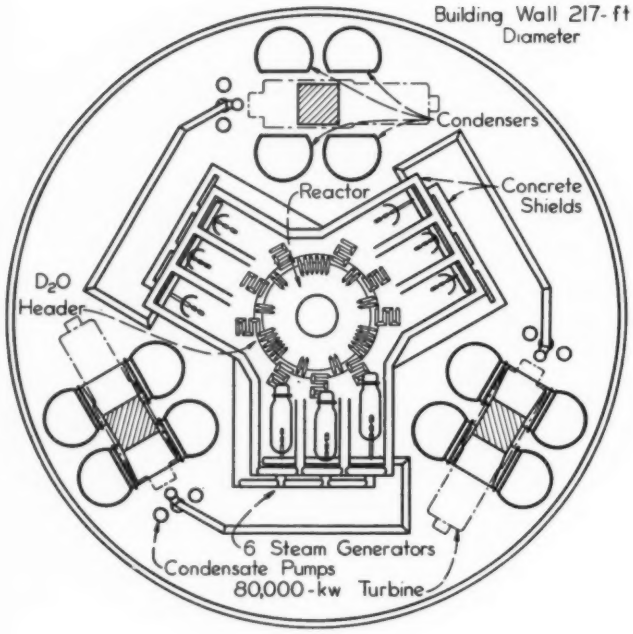
	Commonwealth Edison Co. Public Service Co. of No. Illinois		Pacific Gas & Electric Co. Bechtel Corp.		Monsanto Chemical Co. Union Carbide Co.	
Reactor data	***Plant A***	***Plant B***	***Plant C***	***Plant D***	***Plant E***	***Plant F***
Primary coolant	helium	heavy water	light water	liquid sodium	liquid sodium	liquid sodium
Moderator	graphite	heavy water	heavy water	none	graphite	graphite
Fuel	uranium slugs	uranium	natural uranium	enriched uranium	enriched uranium	enriched uranium
Shielding	cast iron, concrete	steel-lined concrete	concrete	concrete	concrete	concrete
Control method	boron steel rods	boron steel rods	movable plates	blanket	—	—
Plant capacities						
Steam generation	906,000 lb/hr	3,210,000 lb/hr	—	1,600,000 lb/hr	3,000,000 lb/hr	4,800,000 lb/hr
Gross heat	350 mw	1064 mw	500 mw	500 mw	1000 mw	3000 mw
Gross electrical	61.7 mw	225.5 mw	106.2 mw	154.6 mw	220 mw	579 mw
Net electrical	46.7 mw	211.5	100.6 mw	1453 mw	210 mw	554 mw
Capital costs						
Reactor and associated equipment	$11,500,000	$ 48,398,000	$24,350,000	$33,100,000		
Total plant	40,000,000	118,000,000	41,000,000	51,000,000	$26,000,000	$61,000,000
Cost per installed gross kw capacity	$649	$492	$388	$330	$124	$110

MUCH OF THE THINKING REPORTED MAY BE COMPARED DIRECTLY THOUGH INDIVIDUAL ASSUMPTIONS WERE MADE AFTER ALL TEAMS HAD AGREED ON BASIC PRECEPTS. BECAUSE OF ITS FAR-REACHING NATURE, THE DETROIT EDISON-DOW CHEMICAL REPORT WAS NOT RELEASED WITH AS MUCH DETAIL AS SHOWN ABOVE FOR THE OTHERS.

this is the reactor long held to be possible, but only now proved experimentally workable. The breeder burns fissionable material in the presence of non-fissionable material, making the non-fissionable material fissionable and suitable as a fuel for further reactor consumption. When the rate of breeding is faster than the rate of initial consumption, more fuel is made than is burned over-all.

The technology of nuclear breeding is only in the experimental stages. But the reactors now on the drawing board certainly herald the coming day of the breeder.

. . . the liquid-cooled reactor

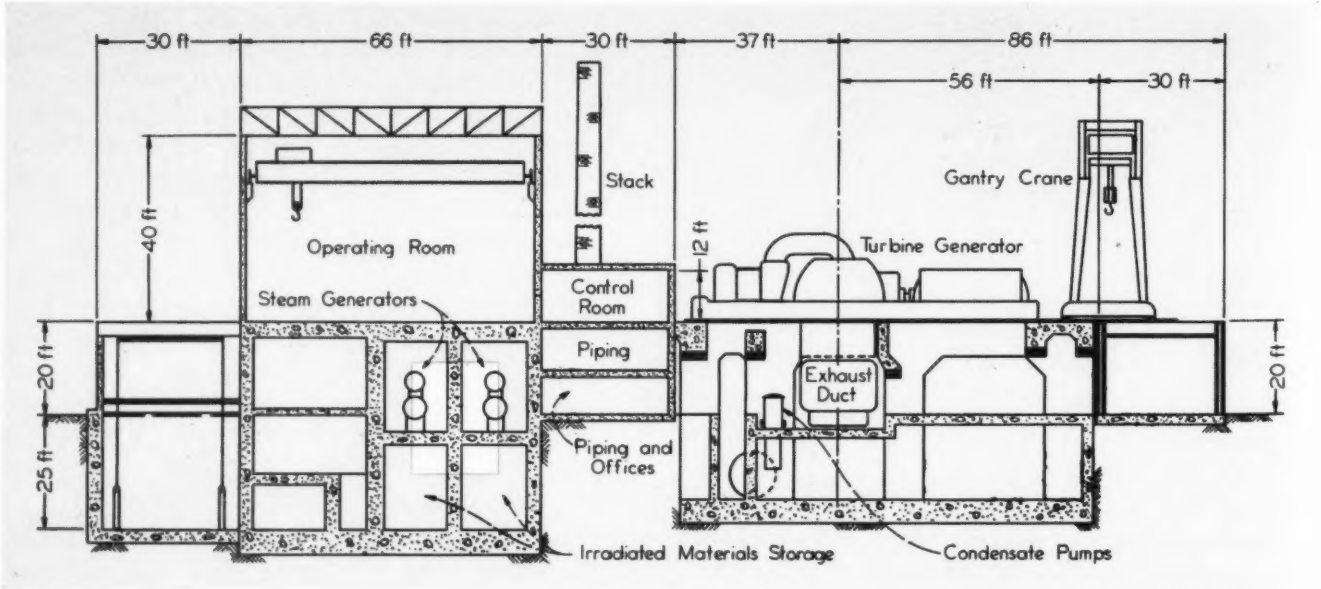


STEAM GENERATORS FORM TIGHT CIRCLE AROUND HEAVY-WATER-COOLED REACTOR TO MINIMIZE PIPING LENGTHS AND COOLANT HOLDUP. HEAVY WATER IS ALSO THE MODERATOR AND REFLECTOR.

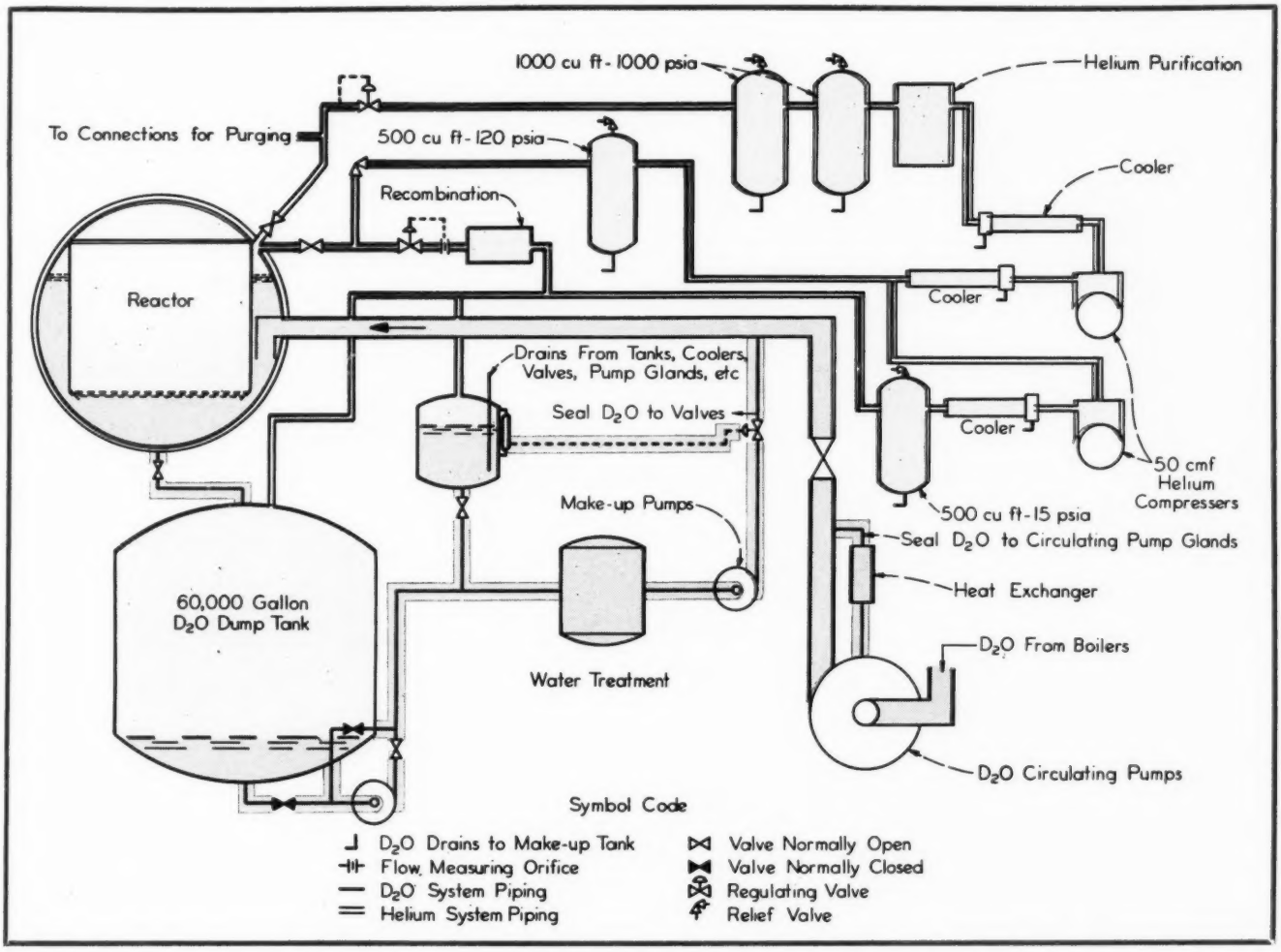
The distinguishing reactor feature commonly used to designate types is the primary coolant material used — the coolant which carries the useful reactor heat to the steam generators. The Pacific Gas-Bechtel survey team investigated two kinds of reactors, one being the liquid-cooled type using ordinary water (H_2O) as the coolant. This reactor was chosen for cost studies because it can be designed and built more quickly than other types and its cost can be predicted with some degree of certainty.

A preliminary design of a water-cooled, natural uranium reactor was worked out. Essentially, the reactor consists of an aluminum tank with an array of aluminum tubes between tube sheets, the tubes serving as the container of the *moderating* heavy water. The fuel is placed in pressure tubes extending through the core tank concentric with the aluminum tubes. Light water, the primary coolant, flows through the pressure tubes.

Control of the reactor is effected by plates, located at intervals around the periphery of the core tank; the plates slide in and out of aluminum sheaths actuated by a servomotor connected to the control system. The principal engineering problems to be solved for this reactor are the determination of mech-



THEORETICAL ATOMIC GENERATING STATION BUILT AROUND LIGHT-WATER-COOLED REACTOR. REACTOR IS LOCATED BEHIND STEAM GENERATORS (WHITE AREA) AND IN LINE WITH TURBINE-GENERATOR SHAFT. STEAM GENERATORS ARE LOCATED ON BOTH SIDES OF THE REACTOR (GENERATORS ON NEAR SIDE ONLY SHOWN ABOVE).



A CIRCULATING SYSTEM KEEPS HELIUM BLANKET ON HEAVY WATER SURFACES TO PREVENT CONTAMINATION.

anisms, their transfer functions, and the reactor transient response.

Operating Personnel

The number of operating personnel will be high for the first dual-purpose reactor; the estimated requirements to man all shifts excluding maintenance personnel are:

Reactor plant operation	46
Health physics	16
Technical services	13
Security	22
Administration	6
Power plant operation	14
Total	117

Heavy-Water-Cooled Reactor

The Commonwealth Edison-Public Service team investigated a liquid-cooled reactor using heavy water (D_2O) as the primary coolant, moderator, and reflector. The principal component of the reactor — the fuel assembly — is composed of a number of fuel elements hanging vertically. Each fuel element consists of uranium in a thin metal casing, loaded from the top. The assemblies are placed in cylindrical channels around and through which the heavy water flows parallel to the elements, carrying off the generated heat.

The primary coolant circulates between the reactor and the steam generators; the primary coolant system includes high-capacity circulating pumps, pressurizer, degassifier, emergency cooling pump, gland injection pump, off-gas pump, dump tank, and makeup pump.

A monitor is kept on the amount of heavy water flowing from the reactor and its temperature at each fuel tube outlet and control rod opening. Flow changes indicate defects such as clogged fuel tubes due to warping and leaks. A rapid scanning device for observing temperature and pressures localizes any faults which may develop. The scanning system has predetermined limit settings to initiate alarm and automatic shutdown when any pre-determined limits are exceeded.

A cost analysis shows the following probable allocation of funds:

Heavy water (D_2O)	40%
Reactor, including D_2O system, controls, and plant site development	20%
Parallel plant components of conventional steam turbogenerator plant	40%

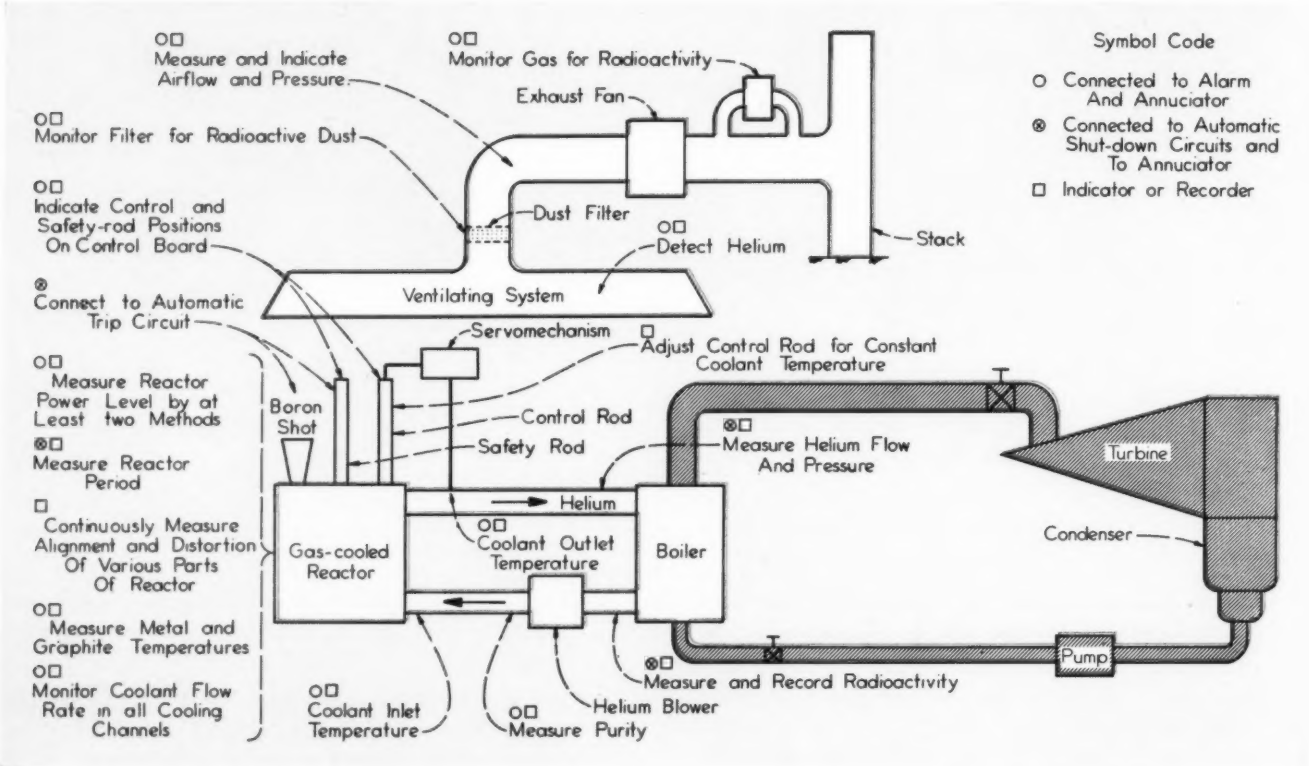
The studies on this installation took into account

current equipment cost estimates; a tentative site was chosen, and an actual plant layout was made.

If the reactor were to be designed for light-water cooling and moderation, requiring enriched fuel, the initial investment could be reduced by 38 percent. This would bring the total capital cost down from $118 million to $71 million; the capital investment per kilowatt of generating capacity would then drop from $492 to $297, for a 225,000 kw plant.

These cost figures assume that fabricated fuel elements are furnished by others; also, the cost of the initial fuel charge has not been included.

. . . the gas-cooled reactor



INSTRUMENTS AND CONTROLS FOR GAS-COOLED REACTOR PERFORM VARIETY OF FUNCTIONS DEPENDING ON NATURE OF MONITORED VARIABLES. IN ORDER OF INCREASING CRITICAL IMPORTANCE IN MAINTAINING ADEQUATE PROTECTION DURING REACTOR OPERATION ARE INDICATORS AND RECORDERS, ALARMS, AND AUTOMATIC SHUTDOWNS.

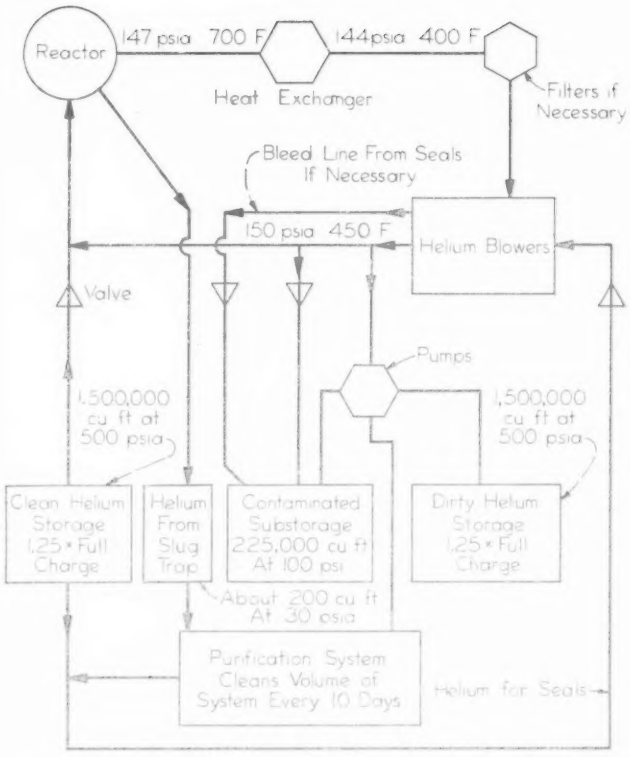
The second reactor type, studied by the Commonwealth Edison-Public Service team, was the helium-cooled, graphite-moderated reactor. There was much information available for study on this type reactor from the engineering, construction, and experience of others. This led to minimized extrapolation of design data.

A gas was sought as the primary coolant which would have acceptable heat-transfer characteristics, desirable nuclear properties, and chemical stability under irradiation. Helium met these requirements. It is an inert gas having no chemical combining tendencies with uranium and having zero neutron-absorption cross section. The gas has a relatively high specific heat but a very low density. The results of design calculations suggest using helium under a pressure of 10 atmospheres. Graphite was selected as the moderator since it provides a desirable combination of nuclear and mechanical properties and is available in the required quantities.

Uranium Temperatures

Common to all reactor design is the problem of uranium temperature. In past designs, the fuel slug has been cylindrical, encased in a protective coating of high-purity aluminum. The previous graphite-moderated reactors using these slugs are all of the low-temperature type. These low temperatures would not be suited to the extraction of heat for power.

In the proposed reactor, the fuel slugs are made of uranium metal with a center hole and with fins to rest on the surfaces of the slug channels in the reactor core. It was assumed that heat is generated uniformly within the metal. The design is aimed at uniform heat flow from all parts of the surface. The


Reactor
147 psia 700 F
144 psia 400 F
Heat Exchanger
Filters if Necessary
Bleed Line From Seals If Necessary
150 psia 450 F
Helium Blowers
Valve
Pumps
1,500,000 cu ft at 500 psia
1,500,000 cu ft at 500 psia
Clean Helium Storage 1.25 × Full Charge
Helium From Slug Trap
Contaminated Substorage 225,000 cu ft At 100 psi
Dirty Helium Storage 1.25 × Full Charge
About 200 cu ft At 30 psia
Purification System Cleans Volume of System Every 10 Days
Helium for Seals

HELIUM SYSTEM REQUIRES 45 ACRES FOR UNDERGROUND STORAGE PLUS 15,000 SQ FT OF BUILDING SPACE FOR CONTROL AND PURIFICATION EQUIPMENT.

maximum internal metal temperature is limited to 1000 F to prevent transformation into the beta phase.

An appreciable increase in reactor power could be achieved by developing an alloy and a casing method which would permit fuel element temperatures above 1000 F. Further investigation is necessary; 1300 F is suggested as the order of magnitude for the improved fuel element.

The reactor is composed of the cylindrically shaped graphite core assembly (985 tons) and a graphite reflector (498 tons), all enclosed in a spherical steel pressure vessel, 44 feet in diameter. Openings in the sphere permit feeding uranium into the graphite core. The fuel elements are cooled by the helium circulating in two directions from a center slot. The shell assembly is encased in an 8-foot thick concrete and cast iron radiation shield.

In order to minimize electrical generating equipment down time, a reactor charging and discharging system is proposed which will operate without shutting down the reactor.

Reactor Instrumentation

The more important reactor instruments measure power level, reactor period, and the temperature and pressure of the heat-transfer medium. The major control function is the operation of the control rods by manual and semiautomatic equipment. The control rods are automatically positioned to maintain constant helium temperature at the boiler inlet. Remote indicator devices on the reactor control board instantly tell the operator the position of the rods. A positive means is used to move the rods with sufficient stored energy to operate them several times through their full travel, even after auxiliary power failure.

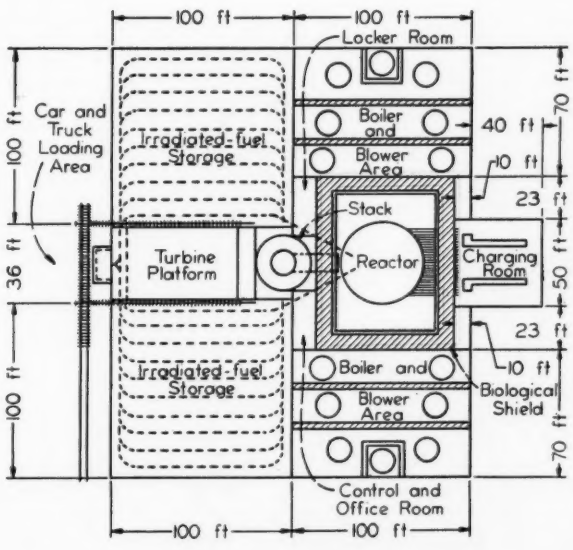
Measurements taken on the helium coolant are flow, pressure, radioactivity, and purity. Defects in the fuel elements or in the helium circulating system may be discovered this way. Radiation leaks are detected by a group of ionization chambers throughout the reactor building, connected to recorders and alarm circuits. These are supplemented by portable instruments.

Helium Circulation

The helium is heated as it circulates through the reactor, then passes through boilers where feedwater is converted into superheated steam. The helium cycle data follow:

Inlet temperature	650 F
Outlet temperature	384 F
Temperature drop	266 F
Specific heat of helium	1.25
Helium circulated, lb/hr	3,270,000
Total heat released, Btu/hr	1,085,000,000
Specific volume at 384 F, 10 atm, cu ft/lb	15.4
Total volume (outlet), cfm	840,000
Specific volume at 650 F, 10 atm, cu ft/lb	20.3
Total volume (input), cfm	1,106,000

Underground storage facilities for 3 million cubic feet of helium at 500 psia are suggested. Included also is a continuously operating helium purification system. An additional uranium inventory in the charging area, in cool-off storage, plus a 90-day re-

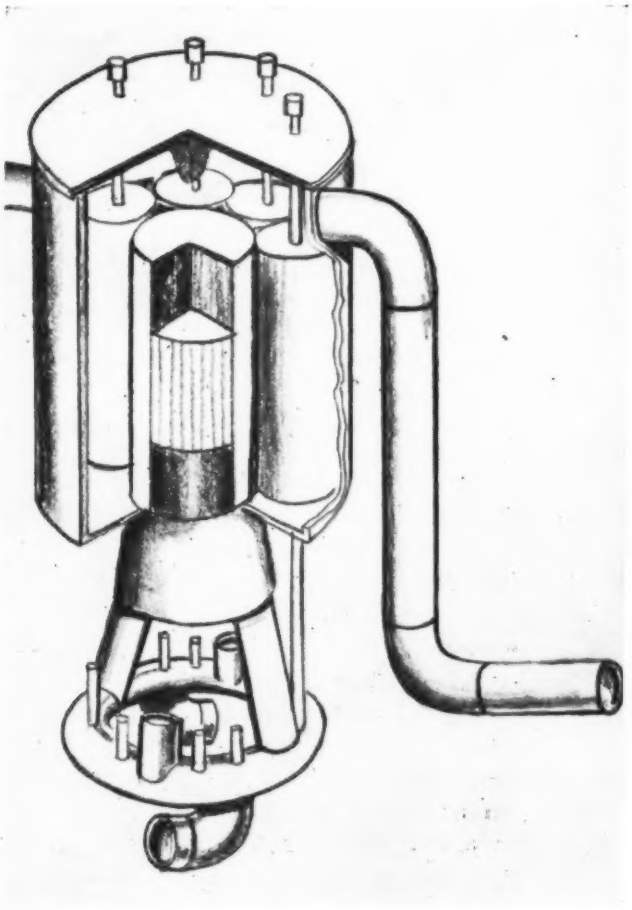


PLANT SITE FOR GAS-COOLED REACTOR USES 100 ACRES PLUS EXCLUSION AREA; IRRADIATED-FUEL UNDER-WATER STORAGE AREAS ARE 40-FT DEEP.

serve amounts to somewhat more than half the reactor loading. About the same amount is thought to be needed for one year's reactor operation.

The costs of this reactor were based on estimates and data supplied from the Brookhaven and Hanford reactors. (See Table of Comparative Data) Figures were modified to meet conditions anticipated in the middle west. Fuel element fabrication and chemical processing facilities for plutonium extraction were not included in these costs.

. . . the liquid-metal-cooled reactor

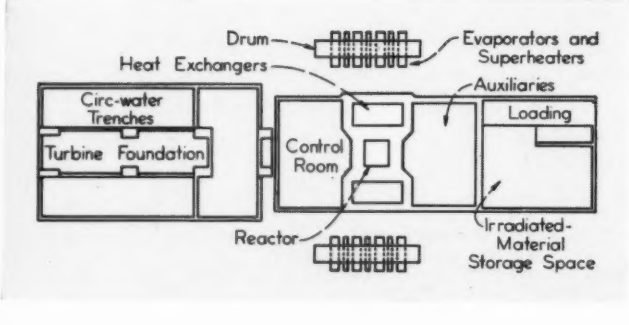


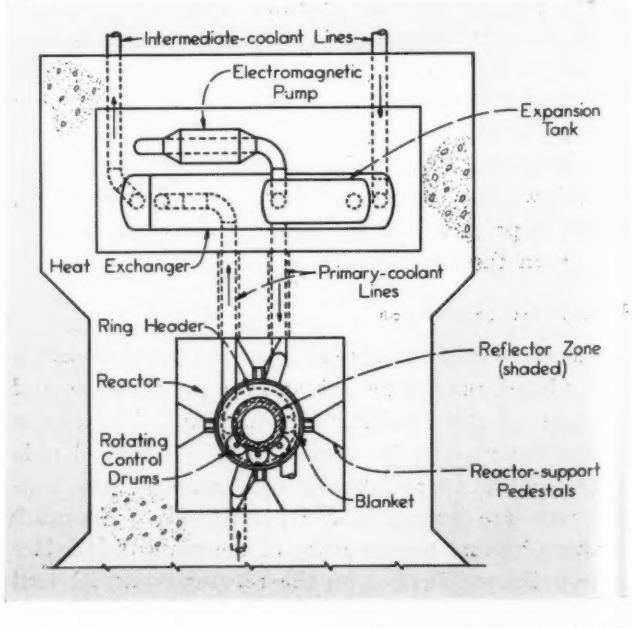
REACTOR PRODUCES 90 PERCENT OF HEAT IN CORE (LEFT); ENCLOSING CYLINDER IS 8 FT HIGH AND 8 FT IN DIAMETER, HAS ACCESS FOR SODIUM, REFUELING, AND CONTROLS.

The Pacific Gas-Bechtel team investigated one reactor of the liquid-metal-cooled breeder type; the Monsanto-Union Electric team studied two liquid-metal-cooled reactors differing from each other only in cooling systems flow arrangements.

Sodium Technology

Both teams selected liquid sodium as the primary coolant for several reasons: sodium has a very high film heat transfer coefficient, a high boiling point, and a low neutron-absorption cross section. It permits a greater temperature rise without pressurization than other coolants. Since plutonium production is nearly proportional to the reactor's heat output, and the value of plutonium is so great, the operating temperatures sodium permit are high enough to maximize plutonium output. This makes generation of electric power economically practical in the near future, one of the basic precepts for the study. Sodium does not corrode stainless steels at temperatures up to 900 F. A large amouunt of data are available about commercial handling of sodium, and much is known about it from corrosion studies made at AEC installations. Heat exchangers for trans-





PROPOSED DUAL PURPOSE PLANT, ABOVE, IS BUILT AROUND LIQUID-METAL-COOLED REACTOR SHOWN IN LIGHT AREA AND ENLARGED AT RIGHT. THE REACTOR CORE (SEE ARTIST CONCEPTION ABOVE) IS MADE UP OF HIGHLY ENRICHED MATERIAL SURROUNDED BY BREEDER BLANKET OF DEPLETED OR NATURAL URANIUM. FUTURE IMPROVED DESIGNS CAN BE BUILT ON THIS PROPOSED BASIC PATTERN.

ferring the reactor-generated heat in the flowing sodium to the water for steam generation would have to be of special construction to prevent accidental contact between the sodium and water. The construction of the exchangers would have to be quite reliable to permit extended operation with little maintenance because of the radioactivity in the sodium. A satisfactory seal for valve stems has been achieved but no sealing device has been found satisfactory for pump shafts. The only solution foreseeable is the electromagnetic pump which is absolutely leakproof but has low efficiency.

Exclusion Areas

The Monsanto-Union Electric studies indicate that very large land areas would be needed for exclusion areas based on the safeguard formula derived for the type reactor on which their study was based. For the size reactor proposed, these areas would be so large it is doubtful if any private industry could plan their acquisition. If the plutonium-power reactor were located where the exclusion area would not involve a prohibitive land expense, the transmission costs would become a serious burden. Reactor safety must be studied further to permit smaller exclusion areas.

As pointed out in the Pacific Gas-Bechtel study, refueling a liquid-sodium-cooled reactor is complicated by the requirement that an atmosphere of inert gas (probably helium) be maintained over the sodium surface at all times. Refueling must not allow air infiltration into the coolant space.

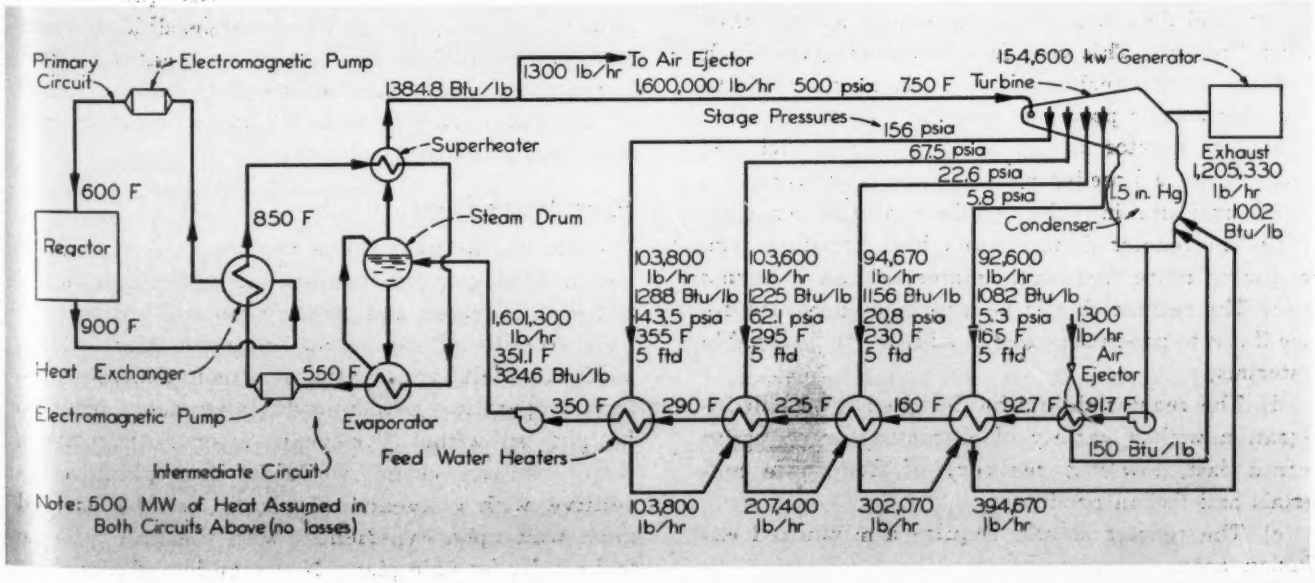
Conclusions of the Pacific Gas-Bechtel group indi-

ECONOMIC ASPECTS OF ATOMIC POWER PRODUCTION

	Cost, Millions of Dollars			
	Case 1	Case 2	Case 3	Case 4
Reactor and power-plant capital				
Site and yard improvement	2.8	2.8	1.1	0.5
Reactor plant	33.1	33.1	16.6	—
Power plant	15.1	15.1	12.1	13.5
Total capital	51.0	51.0	29.8	14.0
Annual capital costs				
Site and yard improvement	0.36	0.36	0.15	—
Reactor plant	4.50	4.50	2.26	—
Power plant	2.05	2.05	1.65	—
Total fixed charges	6.91	6.91	4.06	1.90
Annual operating costs				
Reactor operation and maintenance	1.06	0.74	0.37	—
Power-plant operation and maintenance	0.46	0.46	0.35	—
Total operating cost	1.52	1.20	0.72	0.40
Annual fuel costs				
Including inventory and chemical processing	10.38	4.60	1.50	1.67
Cost of power				
Total annual costs—millions of dollars	18.81	12.71	6.28	4.00
Net capacity, kw	145,000	145,000	160,000	100,000
Net output, million kw-hr	1020	1020	1120	667
Cost, mils/kw-hr	—	12.5	5.5	6.0

Case 1 — Dual-purpose reactor currently conceived for power and plutonium.
Case 2 — Dual-purpose reactor currently conceived operated for power only.
Case 3 — Future improved reactor built for power only.
Case 4 — Conventional steam power plant.

Note: Some of the inherent basic assumptions in above data include amortization period of 20 years for atomic plant facilities; financing is by private utility; capacity factor is 80 per cent; Case 3 includes cost savings due to improved technology, advanced operating experience and construction of large power block.



HEAT BALANCE IN A SODIUM-COOLED REACTOR USING A LOW-PRESSURE, CONVENTIONAL REGENERATIVE CYCLE.

cate the liquid-metal-cooled fast breeder has the outstanding advantage of conserving the uranium supply and adaptability to high-pressure high-temperature present day plants. This makes this reactor attractive as a power producer. Looking beyond the scope of the present studies, they conclude the liquid-fuel, fast breeder reactor has the greatest possibility of low cost power production though the amount of development yet required precludes construction of such a reactor in the immediate future.

. . . the way ahead

The air is full of nuclear thinking as befits the impending impact of atomic energy on civilian affairs. Clearing the air completely is more than can be hoped for at this stage. But selected points of view indicate the trends developing—the way ahead.

Legal Questions

The Atomic Energy Act was framed at a time when the nation had neither the knowledge, the experience, nor the perspective it has today. We then thought of atomic energy development strictly as a weapons program; we were in possession of one vast military secret, and that an agreement for international control was in the offing.

It will not be much easier to split the atomic energy industry in two than it was to split the atom itself—keeping one part under military wraps and releasing the other openly to industry. But the reasons for changing the law to permit industry a freer role are compelling: the lack of continuing competitive stimulus will only weaken any such long-term monopoly as now exists; there is an inherent difficulty in the government running a new industry whose vast areas of science and technology hold vital potentialities for new products and processes; the interest of industry is continuing to increase.

Technological Goals

The studies of the Detroit Edison-Dow Chemical team were so far-reaching they precluded disclosure of technical details to the same extent as the other groups' reports. This very fact, however, gives much credence to the technological goals prerequisite to economic atomic power as seen by this group:

(a) The reactor should utilize low-cost fuel, i.e., it should be a breeder which in itself converts depleted uranium into fissionable material for fuel;

(b) The reactor should have a high breeding gain, producing more fissionable material than it burns;

(c) The reactor should be a high-temperature device if it is to produce power in addition to fissionable materials;

(d) The reactor should be designed to permit integration with a variety of extraction processes to permit fast, low-cost recovery of fissionable materials and fission products;

(e) The reactor should require a minimized exclusion area;

(f) The reactor should use mobile, or liquid, fuel;

(g) The reactor should be a self-regulating one.

Present Limitations

The limitations presently seen on reactor progress point to the targets for immediate attention:

(a) There is no precedent for evaluation of the estimated costs which will have to be underwritten; translation of AEC figures into utility cost analysis terms is difficult;

(b) Obsolescence factors in a new technological field must be estimated without past experience; and

(c) Private ownership of a reactor and fissionable material is not yet permissible under the law; any firm venturing into the field would be dependent on the AEC.

Associated Industries

The advent of commercial atomic power will certainly have an impact on associated industries. While some see atomic power as a bridge between man's use of fossil fuels and his use of solar energy, this long-term point of view solves none of the more immediate problems as may be seen by coal, oil, and gas producers, or by real estate and financial men, or by labor leaders, or by those charged with maintenance of the public safety.

Certainly, shifts on the economic scene will be generated along with atomic power. Industries are expected to grow and decentralize. The comparatively weightless atomic fuels will bring vast quantities of power to places where it was never feasible to transport the equivalent amounts of conventional fuel. Large power levels can be brought near the source of important raw materials from deserts, from mountains, and from islands.

When Atomic Power

When can we have the power reactor? An experimental homogeneous reactor — using a single liquid as fuel, moderator, and primary coolant—turned the trick recently (CONSULTING ENGINEER, March 1953, p. 58). It is felt by many that it is technically feasible for an operating power-producing reactor plant to be put up within five years after authorization. How soon an *economically* feasible plant, competitive with conventional plants, can be erected must wait upon experiences with the first full-size *technically* feasible plant. None-the-less, fissionable-fueled power generation appears not far off.

Subcontract Your Drafting

HARRY E. KRAUSS, JR., Vice President
Foster-Vrooman-Krauss Company

Mr. Krauss, a registered professional engineer in both Pennsylvania and New Jersey and a mechanical engineering graduate of Drexel Institute of Technology, is a member of ASME, United States Naval Institute, American Society of Military Engineers, and the Army Ordnance Association. His experience, before joining Foster-Vrooman-Krauss in 1948, includes machine design, tool design, utility, electrical, and civil engineering.

WHEN AN ARCHITECTURAL FIRM recently received a contract for major revision of a large South American brewery, it was faced with several important problems. The plans, sent from South America by the owners, were found to be in three different sizes, having been prepared over a long period of time with different drafting standards.

To provide standardization of the work, it was decided to make all drawings uniform in all respects. The basic process function and flow diagrams were worked out as a series of rough sketches. These were used to indicate how the new facilities would be attached to existing facilities. In addition, they served as the major control for the project. Once this was done, it was possible to divide the project into its various components.

Before detailed plans of any of the components could be made, however, it was necessary to have

(Continued on page 62)

Hurdles to clear in strengthening Brazil's industrial productivity are observed by an engineer while in Brazil, laying the groundwork for the technical teams the United States is sending to Latin America under Point Four.

THE IDEA OF FOREIGN CAPITAL FINANCING DEVELOPMENT OF BRAZIL'S RESOURCES (LEFT) HAS BEEN POLITICAL DYNAMITE THERE, SLOWING GROWTH OF MODERN INDUSTRIES AND CITIES SUCH AS SAO PAULO (BELOW).

Pan American World Airways

Boosting Brazil's Industrial Might

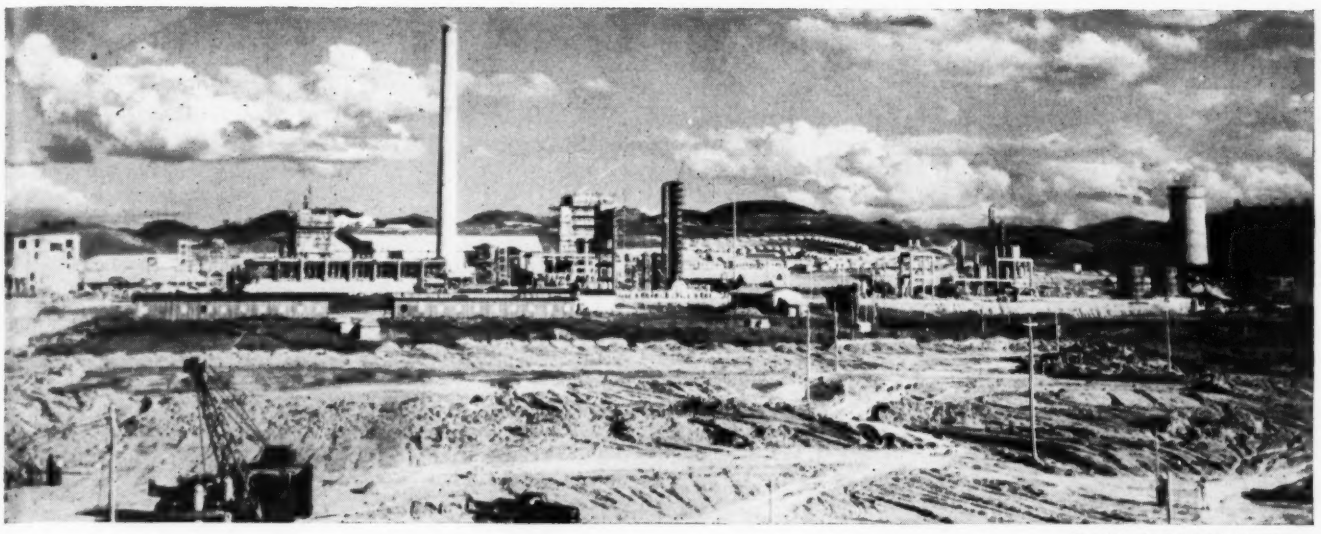
JOHN A. PATTON
John A. Patton Management Engineers

MAJOR QUESTIONS have developed from the first studies of the groups seeking to set up the Point Four program aimed at increasing Brazil's industrial productivity: to what extent can modern engineering techniques be applied to Brazil's economic problems; are Brazilian industries ready for the application of such techniques; how will Brazilian industrialists react to suggestions for technical advances in materials handling, mechanical equipment, electrification, methods improvement, plant layout, and better utilization of labor?

In the initial inspection trip of some four weeks, some basic facts on industrial conditions and management attitudes were secured which will lead to the answers.

First, any attempts at force-feeding Brazilian industry with technical know-how could only fail. Before any attempt can be made to put American technical knowledge to work in Brazil, there must be a thorough understanding of the many obstacles and handicaps Brazilian industry faces—obstacles and handicaps that may be difficult for outsiders here to imagine.

Second, an obvious assumption of superiority would, as it has in the past elsewhere, result in slowing up whatever eagerness to improve may exist among Brazilian industrialists. It is easy to fall into this error since those conversant with industrial engineering techniques can readily see the lack of management tools in Brazilian industry. This often leads to a show of presumed superiority, manifest by quick and insistent pointing up of the deficiencies in



Pan American World Airways

CONSTRUCTION SITE OF THE VOLTA-REDONDA STEEL MILL MARKS STEP IN BRAZIL'S INDUSTRIAL DEVELOPMENT.

Brazilian management. But enthusiasm about the possibility of an industrial productivity strengthening program was immediately expressed by the Brazilians; such enthusiasm must be the starting point of any changes in engineering techniques.

Problems to Conquer

Frankly, one cannot but be impressed by what has been accomplished already in Brazil, considering the obstacles and handicaps facing the average industrialist. The obvious market limitations, the lack of standardization, and the inability to import needed and necessary equipment and raw materials are some of the problems which must be met today in Brazil. These problems must be conquered before better mass production methods can be installed with any certainty that they will increase production and subsequently increase the standard of living.

Some of Brazil's industrial problems are undoubtedly due to the effects of inflation and lack of investment capital with which to finance her rapid economic development. There are heavy demands ahead from a billion-dollar general development program in transportation and other facilities, to diversify the country's economy and to expand its exports.

Incentive Deficiencies

With such problems to solve, it is understandable that technical assistance alone cannot do the job, since there is a basic deficiency in the incentive among industrialists to produce volume. To make matters more difficult, there is little incentive among employees to work harder at their jobs. Basically, this last problem lies in the fact that the average worker cannot earn enough to buy the products he helps make.

Another fact which cannot be overlooked in the

(Continued on page 64)

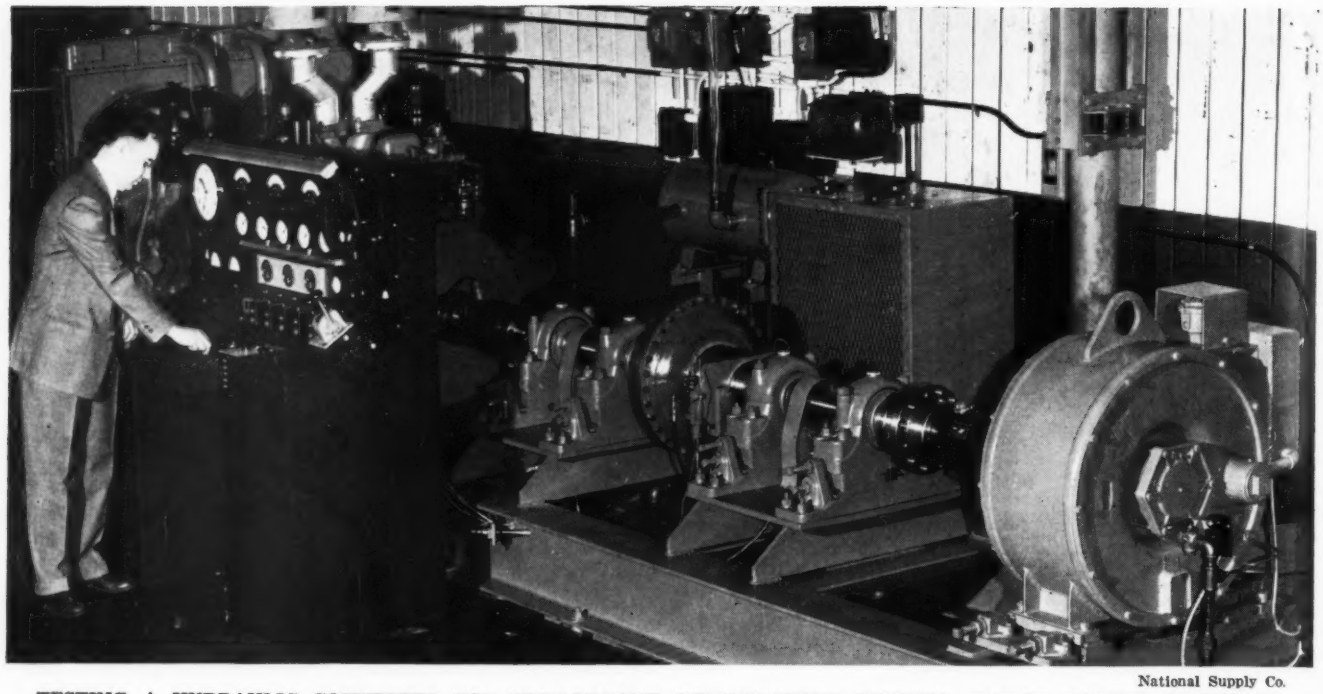
CONSULTING ENGINEERS HELP

Consulting engineers will play a large part in the technical assistance programs getting under way in Latin America under the United States' Point Four Program. In the effort to strengthen friendly countries, a major effort is being put behind the accelerated development of their industrial productivity under the stimulation of United States' know-how. The Institute of Inter-American Affairs has helped establish service bureaus in the field of industrial productivity under the Point Four Technical Assistance programs for Chile and Brazil.

A small staff of United States industrial professional people are assigned to the service bureaus to give technical guidance. The accompanying article was written by an engineer who went to Brazil to help survey conditions in order that the first steps of the program could be planned most effectively.

The work of the advisory staff is primarily concerned with basic industries and essential commodities; typical are textiles, leather goods, processed foods, metal products, tools, and small capital goods. Functional experts will be called on for aid in fundamental engineering techniques including production planning, control systems, plant layout, materials handling, methods engineering, process methods, and labor-management relations. Factory perform-

The program is under the joint supervision of United States and Latin American directors and their staffs for engineering, cost accounting, and productivity analysis.



National Supply Co.

TESTING A HYDRAULIC CONVERTER FOR HIGH-TORQUE MEDIUM-SPEED ENGINES. POWER RANGES 325-1000 HP.

Torque and Speed
In Mechanical Power Transmissions

JOHN C. HITT
Jackson & Moreland, Engineers

John C. Hitt is a graduate electrical engineer from the University of Washington and Massachusetts Institute of Technology. After working on field and office assignments with Jackson & Moreland, in Boston, he became Plant Electrical Engineer of the Baldwin Locomotive Works in Philadelphia. In 1947, he rejoined Jackson & Moreland and since then has been acting as project manager on various public utility and industrial consulting projects.

THE SQUIRREL-CAGE induction motor with its simplicity, reliability and low cost, is one of the faithful servants of our modern industrial world. However, it has one serious drawback—it is basically a single-speed device—and many applications require varying and readily adjustable speeds. That requirement has been met with mechanical and electrical speed changing devices.

From the standpoint of adjustable speed control, a friction clutch, a wound rotor induction motor, a hydraulic coupling, and an electromagnetic coupling, all have a certain equivalence.

There is another equivalence among Ward-Leonard type of electric drives, Reeves, Link-Belt, or Graham mechanical drives, and Vickers type of hydraulic drives.

How the particular load torque varies with speed is a fundamental consideration in applying these various devices successfully.

Slip Couplings

Types of slip couplings for speed control includes simple hydraulic couplings, electromagnetic couplings, magnetic particle couplings, and wound rotor induction motors. In regard to torque and power relationships, they are analogous to the friction clutch mechanism.

Fig. 1 illustrates an elementary friction clutch.

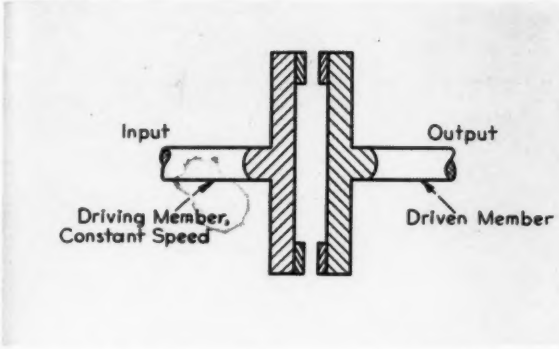


FIG. 1—AN ELEMENTARY FRICTION CLUTCH TRANSMITS TORQUE WHEN THE COMPONENT MEMBERS ARE ENGAGED.

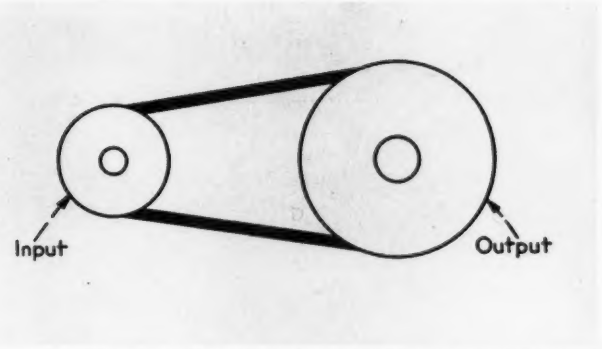


FIG. 2—A PAIR OF PULLEYS WITH DISSIMILIAR DIAMETERS ILLUSTRATES SPEED CHANGE WITH TORQUE CONVERSION.

If the driving member operates at constant speed and the driven member is lightly engaged, the output shaft may operate at some constant speed which is slower than the input speed.

For this simple case, the output torque is that required by the load at the speed at which the output shaft is operating. The input torque must exactly match the output torque, for they result as action and reaction from contact between the two clutch faces on lever arms (radii) which are equal.

Assume that the output speed is held constant, but at a speed lower than the constant input speed —say 60 percent of it. Horsepower being basically torque times speed, it follows that of the 100 percent power input only 60 percent appears as output. The remaining 40 percent is slip power loss, which is dissipated as heat at the clutch faces.

Therefore, for slip couplings, it is evident: (1) that input and output torque are equal; (2) That there is a power loss appearing as heat which is proportional to the input power as the slip rpm is to the input rpm; (3) That the theoretical efficiency is equal to the ratio of output speed to input speed.

Torque Converters

Consider next the case of a pair of pulleys of dissimilar diameters illustrated in Fig. 2. The input shaft turns faster than the output shaft but with less torque. Theoretically there is no power loss. This is speed change with torque conversion. If the diameter of either is varied, it becomes an adjustable speed drive with theoretically no slip-power loss between shafts.

In the torque-converter category of adjustable speed drives, that are in theory 100% efficient, there are mechanical drives similar to pulleys of adjustable diameter. Others are equivalent to planetary transmissions with gears of adjustable diameter.

A positive displacement hydraulic pump and motor system is functionally similar. It consists of a hydraulic motor whose speed is proportional to the quantity flow of fluid through it, supplied by a constant speed pump whose rate of discharge can be mechanically adjusted. Thus a constant input speed to the pump is converted to an adjustable output speed of the hydraulic motor.

The familiar electrical Ward-Leonard system is similar in principle. The constant-speed pump becomes a constant-speed d-c generator, and the adjustable-speed hydraulic motor becomes a d-c motor. The system is still basically a torque converter, in the sense that there is no slip-power loss associated with operation at output speed lower than input speed to the driver.

In other words, if the adjustable-speed system can convert torque in the same inverse ratio as it converts speed, no loss results. On the other hand, a slip coupling is basically incapable of converting torque, and a reduced output speed means corresponding power loss.

Operation of an adjustable speed drive is affected by the torque-speed characteristic. Therefore

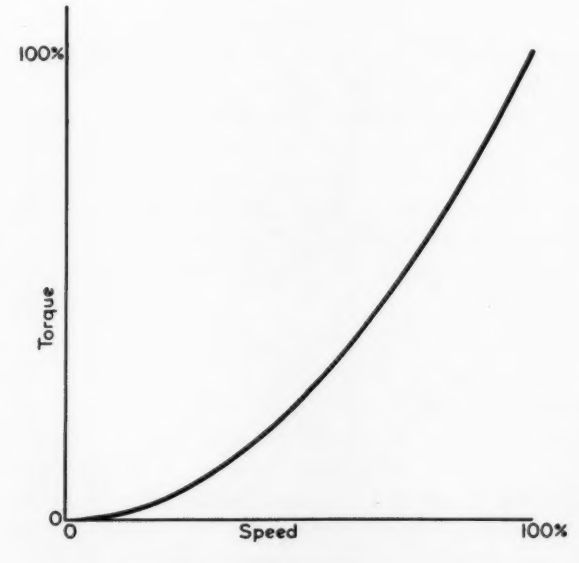


FIG. 3—"FAN CURVE." OF CENTRIFUGAL PUMP AND FAN SHOWS TORQUE PROPORTIONAL TO SQUARE OF SPEED.

FIG. 4—SOLID LINES SHOW A SERIES OF CHARACTERISTIC TORQUE-SPEED CURVES FOR ADJUSTABLE SPEED DRIVE.

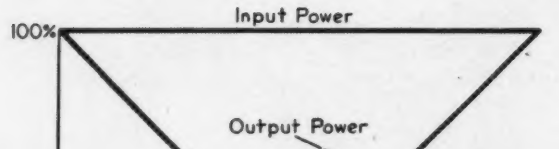


FIG. 5—VARIATION OF INPUT, OUTPUT, SLIP POWER FOR CONSTANT-TORQUE ARE STRAIGHT LINE FUNCTIONS.

the torque-speed characteristic of a constant-torque load, such as an elevator, is constant. The so-called "fan curve," representative of centrifugal pump and fan loads, shows torque as proportional to the square of speed (Fig. 3). These two particular types of load characteristics present very different speed control problems.

Drive Characteristics

The torque-converter type of system is really a "speed converter". With a constant input speed to the adjustable-speed drive a definite output speed can be chosen for the load. The load torque is that indicated by the load's torque-speed curve, and the input torque to the adjustable-speed system is the load torque times the inverse of the speed ratio.

A similar analysis of the slip-coupling type of drive is more difficult. The output speed of the drive (the load speed) is not directly controllable. The variable is the torque-transmitting ability of the drive. This may be the clutch-face pressure for a friction clutch; or the amount of fluid in a simple hydraulic coupling; or the excitation current of an electromagnetic or magnetic-particle coupling; or the resistance in the rotor circuit of a wound-rotor induction motor. Setting any one of these variables determines a particular torque versus speed curve for the adjustable-speed drive.

The output speed of the drive is determined by the intersection of the particular drive-characteristic curve and the load-characteristic curve. Changing the variable factor of the drive shifts the intersection point to another characteristic curve, and by this means speed adjustment is obtained—but indirectly, for it is really the torque transmitting ability of the drive which is being adjusted.

The solid lines in Fig. 4 represent a series of these torque-speed characteristic curves for an adjustable-speed drive (reasonably typical for a hydraulic or electromagnetic coupling or a wound-rotor motor). Note that at low load torques substantially no speed control is available.

Line "a" represents the "tightest" available coupling, obtained with the maximum amount of fluid in a hydraulic coupling, or maximum excitation current in an electromagnetic coupling, or minimum resistance in a wound-rotor motor.

Line "b" is a "loose coupling" condition, obtained with a small quantity of hydraulic fluid or a small electric-coupling excitation. In the case of a wound-rotor motor it represents a large resistance in the rotor circuit.

Combined Characteristics

The two dotted lines on Fig. 4 are the two load characteristics of the constant torque and of the fan curve. Point "x" is the full-load, full-speed operating point at a speed a few percent below the no-load speed.

It is apparent that with a large constant-torque load, a full range of speed down to zero is available by a relatively small adjustment of the torque-controlling medium of the drive.

However, with a fan curve load even the extreme

adjustment represented by curve "b" results only in speed "y." Operation at point "y" or a lower speed is inadvisable because of poor stability of the drive system. The lower the desired operating speed, the more nearly horizontal become the load and drive characteristic curves, with the result that a small change in load torque or torque transmitting ability results in a large change in speed.

Slip Power Loss

In practical adjustable-speed drive applications, the slip-coupling type usually has lower first cost than others, but the slip-power loss represents an extra operating cost which may be appreciable.

On Fig. 7 the curve of output power is the "fan curve" characteristic of load horsepower versus speed, corresponding to the torque-speed curve of Fig. 3. It will be apparent that the percentage of input power which is wasted as slip power keeps increasing as speed goes all of the way down to zero, but the actual magnitude of the slip power reaches a maximum at some intermediate speed. For a fan-curve load, the slip-power loss is at its maximum of 15 percent at the two-thirds output speed point (one-third slip).

In a general case the slip power is expressed as follows:

$P_s = S\ (1 - S)^{n-1}$

P_s = Slip power, as a percentage of total input (or output) power at 100 percent speed.

S = Slip, or $\dfrac{\text{input - output}}{\text{input}}$ speed

n Exponent of horsepower - speed curve for load - hp = speed^n

The maximum value of slip power is expressed as follows:

$$P_{sm} = \frac{1}{n}\left(\frac{n-1}{n}\right)^{n-1}$$

P_{sm} = Maximum value of slip power

The slip at which the above maximum slip power occurs is expressed as follows:

$$S = \frac{1}{n}$$

The maximum amount of slip power thus varies with the type of load being driven, as follows:

	Maximum slip power percent of input-output at 100% speed	Percentage of slip at which maximum slip power occurs
Horsepower proportional to speed	100%	100%
Horsepower proportional to speed squared	25%	50%
Horsepower proportional to speed cubed ("fan curve")	15%	33%

Fig. 5 shows the variation of input, output, and slip power for constant-torque load.

Fig. 6 shows corresponding curves for a load whose horsepower is proportional to the square of the speed.

Fig. 7 is for the "fan curve" case-load horsepower varying as the cube of speed.

Practical Application

It is apparent that a slip coupling, which in itself is a simpler device than a torque-converter type of drive, is apt to prove more attractive in over-all respects for a "fan curve" type of load than for

(Continued on page 65)

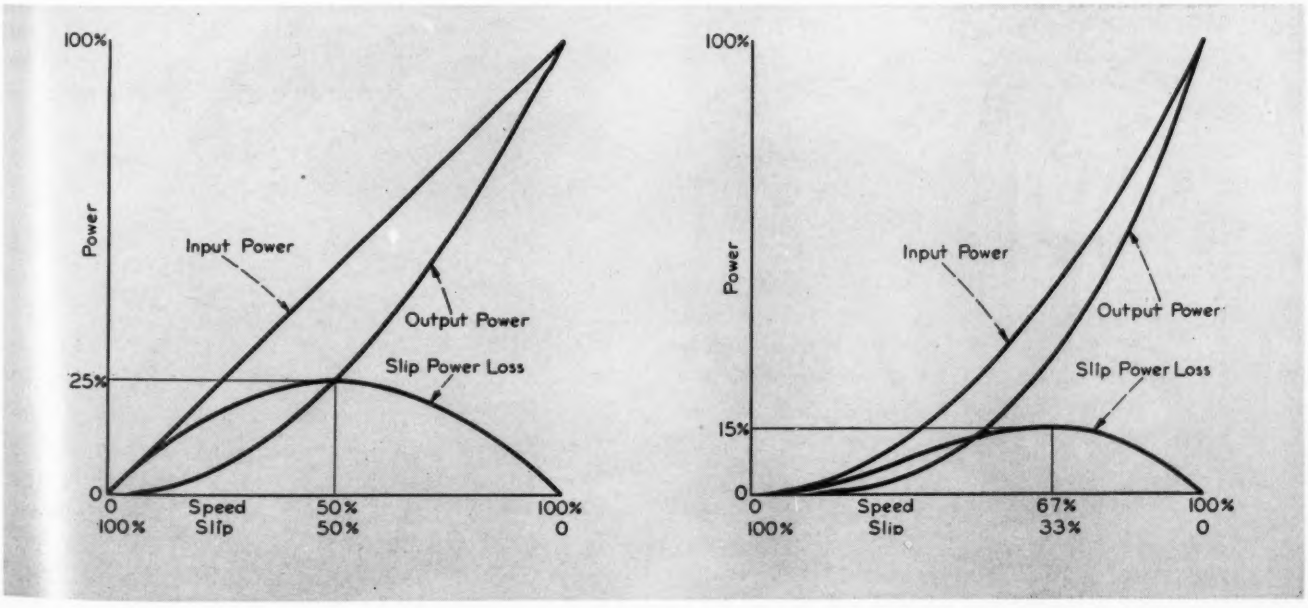


FIG. 6—CURVES FOR A LOAD WHOSE HORSEPOWER IS PROPORTIONAL TO THE SQUARE OF THE SPEED.

FIG. 7—CURVES FOR "FAN CURVE" CASE WHERE LOAD HORSEPOWER VARIES AS THE CUBE OF SPEED.

Rx for Management

J. W. DEVINE
Consultants for Management, Inc.

GOVERNMENT LEADERS and others in the field of economic evaluation have been advising us that the present condition of our economy is sound. Also, that if peace comes, the required adjustments resulting from cuts in military spending can be made without causing a major recession or basically changing the over-all business picture.

In view of these reports and comments and for the purpose of evaluating the possible changes, it is well that we analyze the current business picture and determine for ourselves what these changes will mean.

As to the over-all outlook, the picture is quite confused. Current reports indicate profits are in most cases at the highest levels on record. So are costs. This situation is not compatible. Many management men are of the opinion that business cannot continue at its present high rate of activity, while others, basing their opinions on statistical projections and evaluations of growths within the economy, see not only continued operation at the present high level but actually see a growth to even higher levels.

For the last twenty years we have seen government become more aware of a business than business itself;

coupled with this, class legislation in both economic and social life has reached a new high. To support the expansion of government services and the high cost of armament, tax rates have been set at an almost confiscatory level. In addition to the high level of fiscal spending, the government debt has grown to a point that challenges the imagination.

This whole picture is further confused by an international situation which appears impossible to fathom. It seems that we cannot correct our past errors in foreign relations without creating new ones. It is recognized that such a tangled mess of government, business, people, nations, and taxes, has not developed overnight and it is further recognized that this situation cannot be quickly corrected.

From a practical point of view, regardless of how bad the situation, we must operate our business under these conditions. The questions of prosperity or depression, increased or decreased governmental control, war or peace, pose certain definite problems for management.

The base of the problem appears to be in the correction of governmental policies so as to permit a freer functioning on all parts of the economy. Management consultants must be on the alert to thoroughly acquaint themselves with what is happening to prices, materials, and markets, as a result of governmental policy changes and to evaluate these changes in terms of their client's business, recommending the necessary internal adjustments to properly reflect the changing conditions.

It seems evident that the government has a program. Based on the pattern being developed, we may no longer be required to live under conditions of continued crises, at least from the domestic point of view. But the only sound program that can be followed by business is one based on complete flexibility. To acquire the needed flexibility each management group must learn where it stands. To make sure of our own individual position we must examine the areas of organization and leadership, sales, production and cost control, and finance.

Organization and Leadership

An efficient organization is one through which management can set up a plan and have the plan carried out. Today, too many businesses do not have a plan. Too many owners or managers feel that the business will manage itself, and they hesitate to make plans, fearing conditions are too unstable. Conditions will always be unstable, and management is most effective when it can set its plan and then make allowances for unseen changes as they develop.

Keep in mind that in the past five to six years we have changed from war to peace and are presently gearing for war. Of necessity, the plan for each of these various areas of operation is different and the company that recognized this difference carries on its operation more effectively. At present the situation is doubly difficult and dangerous in that we are gearing for war activity and must at the same time meet increased demands in the way of domestic operation.

There is a definite lack of business leadership today. In part this is an outgrowth of the war when the "cream of the crop" was taught the art of battle for a period of five years or more. Such training did not fit these men for the management problems they currently face. This lack is also due to the outgrowth of governmental policy. Bear in mind that since 1940 business has been out of gear as a result of abnormal demands being made on material, labor, and supplies. Management training has been towards a controlled rather than a free economy.

Regardless of the cause of the present situation, we must recognize that most managements have been under the heavy pressure of tremendous war production, followed by abnormal markets of 1946 to 1952, plus the growing deficit of management replacements, and many of the leaders of business are both physically tired and mentally incapable of meeting the pressure of present problems.

Also, in a number of instances, management has grown old because of the failure of replacements, and active service has been carried on long past a sensible retirement age. In isolated cases this is not serious, but as a program it is deadly. Add to this situation the unfavorable personal tax setup, and we have just about eliminated any personal incentive for any action other than a relaxing of effort on the part of many key people. It is now imperative that we set out on a program of revitalization or replacement of many of the top people in order to restore leadership.

New blood offers a solution but requires an investment of time, effort, and money. Every year big

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John W. Devine

John W. Devine, a graduate of the University of Pittsburgh and the Duquesne University Law School, is a lecturer in the graduate schools of both of these universities and vice president of Consultants for Management, Inc. This organization advises management in such fields as organization, cost, engineering, finance, law, and taxation. It also has a special service for its clients in the field of renegotiation of contracts.

During World War II, Mr. Devine served with the War Contract Price Adjustment Board, of the Pittsburgh Ordnance District, and processed over 150 major cases, some of which attracted national attention.

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business secures the best college talent from all parts of the country. This talent is then trained for a period of several years and eventually becomes the fibre from which top management is selected. To secure the required leadership and technical specialization necessary to meet current problems, many businesses have, and all businesses must, embark on a similar program. We must make definite plans to develop our key people.

Selling

As a result of the rapid growth of the nation's population and the current expansion of its production facilities, a good number of the presently planned sales programs are not based on sound ground. On the whole, market research has not been able to keep pace with the rapid changes in our economic life, and the best figures we have for analysis are those that are actually pre-war. If we are not able to adequately evaluate the results of the last few years, present day decisions based on our historical information will be in serious error. The increase of 18 million in population since 1940; shifts in various income groups, with corresponding changes in buying habits due to the currently high wages; the recent expansion of our production facilities; and the effect of new products on already established products and markets must all be considered.

The best approach to the problem is to deal with only up-to-date market information. Check market analyses carefully and make sure the survey group recognizes the importance of current data in evaluating the effect of new products and future market potentials.

Production and Cost Control

Present high operating cost is an aggravated sore spot. These high operating costs are squeezing profit and must be reduced. There is no greater force that will strengthen management and give it more confidence than to know its costs are pared to the bone and that they are one of the low cost producers in their respective field. Both engineering and management consultants are much needed for this job.

One of the most aggravated areas is labor costs. We can accept the idea that there is nothing wrong with high labor costs providing they are created hand-in-hand with high production quotas, but in many situations the high labor costs result not from high wages, but from a combination of high wages and low labor productivity. In order to meet this situation and to carry on profitable operations, management must mechanize. It is recognized that this means increased fixed charges, but this problem must be met and faced, and management must exercise a new degree of skill and ingenuity in dealing with these capital costs.

Standards and controls must be established for all elements of cost. Standards for material, labor, and overhead must be established fairly and equitably and rewards set up for betterment of these standards. Reasons for variations from the established standards must be analyzed and proper and corrective measures taken to remedy any non-profitable areas. There is only one sound system for the establishment of standards and the measurement of variation from these standards, and that is the simplest system possible. If we recognize our problem, analyze it thoroughly, and strive to make our system adequate but simple, it will be understood by all and will be effective in its operation. By such an approach we will achieve our aim in regard to production and cost controls, and we will indirectly save in the reduction of the expense for accounting and other cost measurements.

The use of budgets and forecasts can be a highly effective tool in the control of cost. The budget must be a realistic plan developed and built up by the various levels of management. If it is sound and properly prepared, it can be used to force the management groups to plan a month, a quarter, or even a year ahead and to measure performance with reference to this plan.

In connection with any sound cost control, materials must be considered. During and since the war, both the availability and price of materials has been troublesome, and the inventory status of most companies needs a thorough review. In mid-1949 we had a downward adjustment in price plus a restoration of regular products in place of war substitutes. At that time sound management called for a complete inventory review to dispose of high priced, slow moving items or items made of substitute materials. At the present time we have a problem that is equally difficult, as we must project ourselves into war work and at the same time continue to manufacture to satisfy commercial demands. If we are to do an effective production job, our inventories must fit our production needs. Inventories must be analyzed to be sure they are geared to current requirements.

Finance

During the past year business after business has found that their cash has become scarce. Many businesses are now taking more than the normal period to pay their bills. Some have found it necessary to pass up discounts to relieve immediate pressure.

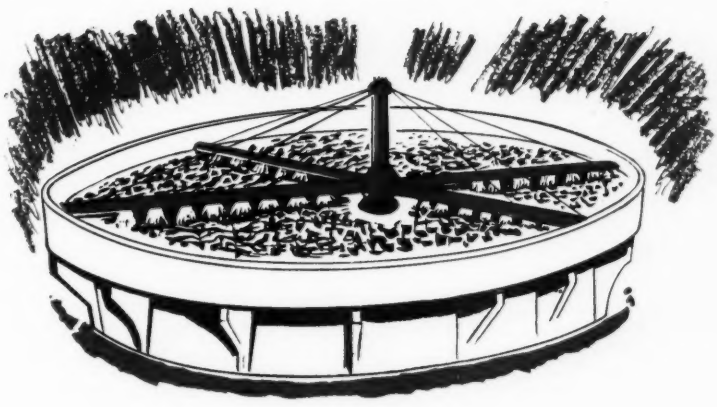
The current pressures on available working fund requirements for materials, labor, and other items of cost have resulted from continued increase in prices, high cost of facility replacement and repair, and the constantly increasing tax outlays. As many businesses are not in a position to accumulate cash reserves and have not developed outside sources of capital, they cannot look for anything but trouble in the next few years.

As evidenced in the past, one of the vulnerable

(Continued on page 63)

States Aid Financing Of Waste Disposal Projects

PROPOSALS to curb water pollution from both industrial wastes and municipal sewage have recently attracted widespread attention in state legislatures. Added impetus has been given to abatement programs by new legislation designed to facilitate financing of abatement plants and equipment.



Of potential significance as a possible model for future action in other states is Wisconsin's enactment of a bill to give industries special tax concessions for money spent on facilities for both water and air pollution abatement. The measure exempts such equipment from local property taxes for five years and allows industries, for state income tax purposes, to amortize the cost of such equipment over a five-year period instead of 20 years.

Under the Wisconsin act, the tax concessions will be allowed for equipment installed by order of the State Committee on Water Pollution, the State Board of Health, or by a city council or village board. Earnings from by-products developed through use of the abatement equipment will be applied as an offset.

Another bill proposed in the Wisconsin legislature, but not yet acted upon, provides State financing of 50 percent of the total cost to municipalities for any pollution abatement equipment ordered by the State.

Further indications that legislators are becoming aware of the need for a means of solving financial problems involved in abatement of water pollution is evidenced in recommendations made by Governor Fine to the legislature of Pennsylvania. In a move to speed the state's clean streams program, he stressed the need for state financial assistance to help distressed municipalities build sewage disposal plants. He also urged amendment of existing state laws dealing with municipal sewage authorities to permit communities to band together to build disposal plants.

Municipal Projects

Bills to facilitate financing of municipal sewage disposal and treatment plants through broadened local borrowing or taxing powers, or both, have been enacted by the legislatures of Indiana, Kansas, Nebraska, Oregon, Utah, and Wisconsin. Such measures are still pending in Alabama, Delaware, and New Jersey.

To aid financing of a $50 million sewer extension and sanitation plant improvement program in Indianapolis, Indiana lawmakers enacted a bill permitting the city to levy a service charge, for use of the city's sewage system, against all non-taxable properties such as churches, colleges, private schools, and government buildings. The new measure also permits the city to make a similar charge to non-city residents who are furnished city sewage service. It further allows the city to charge industries extra for any special sewage treatment.

A bill enacted in Kansas permits cities to impose sewer service charges to pay revenue bonds for sewer extensions and disposal plants. To further curb water pollution, Kansas requires oil drillers to plug exploratory holes with the same safeguards that apply to abandonment of producing wells.

Given legislative approval in Nebraska was a bill to permit the city of Omaha to use sewer fee money for all sewer improvements, instead of for sanitary sewers alone. The measure is intended to clear the way for a proposed $15 million program of storm, sanitary, and combined sewers to be financed by revenue bonds based on a sewer-use fee.

Oregon lawmakers enacted a bill to strengthen efforts of the State Sanitary Authority to clean up streams by making it easier for small communities to finance sewage disposal systems. The act extends the scope of an existing law permitting cities to sell bonds to the State Bond Commission for the purpose of financing sewage disposal systems. The law

originally set up $750,000 for this purpose, and applied to cities up to 2500 population. The new measure appropriates an additional $1 million, and includes towns up to 3500 population within its scope.

A new Utah law permits cities to levy up to 4 mills for construction of sewage disposal and water treatment facilities. Although sought principally by Salt Lake City, the bill is statewide in application.

Enacted in Wisconsin was a bill permitting bond issues of the Milwaukee sewerage commission and the metropolitan sewerage commission to be combined in a single issue. In addition to bonds, it permits improvements to be financed by a tax levy, or by a combination of tax levy and bonds.

A bill introduced in Alabama would revise a law permitting the imposition of municipal sewer fees to pay off bond issues for sewer construction projects. The measure is sought by the city of Montgomery to assure validity of a bond program now being attacked in the courts.

Controls Strengthened

Proposed Delaware legislation would permit cities and towns to create water and sewer authorities by referendum. The authorities would be incorporated and empowered to issue bonds for construction of sewer and water projects. In addition, it permits two or more towns or cities to join together in forming a single authority.

A pending New Jersey bill would enlarge the authority and powers of the Passaic Valley Sewerage Commission and permit that agency to issue bonds as long as 40 years, but not exceeding an aggregate principal amount of $10 million.

West Virginia lawmakers enacted a bill strengthening the State Water Commission's power to curb pollution by making coal company washeries subject to commission proceedings.

States in which new or stronger laws to curb water pollution were enacted this year include New Hampshire, Texas, Utah, and West Virginia, with such measures pending in Alabama. Among the states in which such bills were rejected are Florida, Idaho, and Nebraska. In killing a stream pollution control bill in Nebraska, however, the legislature's public health committee recommended that an interim study of the issue be made by the State Legislative Council.

Results

Several states report continuing progress under existing water pollution abatement laws. A report issued by the California State Regional Water Pollution Control Boards* reveals significant progress by the state's control program during the last three years. The report shows that of 14 critical cases existing when extensive changes in control laws were made in 1949, seven have been solved, two now are being solved, and five have been partially solved. During the three year period, 72 successful bond elections for sewage works costing over $55 million were held, and more than 156 communities constructed sewage facilities costing in excess of $163 million.

"Cooperation from industries as well as communities has been splendid," the report states. "Treatment and disposal facilities have been provided by 85 industries. The citrus packing firms, producers of oil field waste waters, the canning industry, and many others have continued or initiated self improvement programs."

Marked progress in curbing pollution of tidal waters in the New York metropolitan area has been reported by the Interstate Sanitation Commission. In 1935, only 45 million gallons of sewage being poured daily into the waters of the area received adequate treatment. Now, however, adequate treatment is given to 650 million gallons per day. In 1952 alone, plants capable of treating 314 million gallons daily were placed in operation.

By next year, no polluted water will reach the recreational areas from northern Westchester and Rockland counties to Sandy Hook and east to New Haven. By 1959, it is expected that all polluted water now reaching any of the New York metropolitan areas will be eliminated.

The Virginia Water Control Board recently revealed that 65 percent of the state's industries have reduced their stream pollution load since a control board was created in 1946. Over 180 industries have reduced pollution either by process or by treatment. The remaining 35 percent of the industries are small manufacturers which do not present a serious problem. The League of Virginia Municipalities also reports considerable progress toward solving municipal sewage problems.

Court Decisions

Court decisions strengthening efforts to curb water pollution have recently been handed down in several states. Idaho's Supreme Court, for example, upheld the constitutionality of the state revenue bond act under which cities and villages have financed sewage and water systems. The court also held that towns which have water systems may pledge the revenue from them to pay for bonds on new sewage systems.

Constitutionality of Oklahoma City's two-year-old sewer service charge was upheld by the State Supreme Court. A West Virginia Supreme Court ruling early this year affirmed the State Water Commission's authority to order the city of Huntington to stop pollution of both the Ohio and Guyandotte rivers.

* Publication No. 5, "Water Pollution Control Progress Report for 1950 Through 1952." Available from State Water Pollution Control Board, 305 Financial Building, 927 Tenth St., Sacramento 14, California.

Dr. Palyi's Page

Each month on these pages Dr. Melchior Palyi, Consulting Economist, answers readers' questions on economics and finance. Address mail to: Editor, CONSULTING ENGINEER, St. Joseph, Michigan.

- **Looking Over the Economic Picture**
- **Inflationary and Deflationary Pressures**

What are some of the inflationary pressures behind the appearance of our current national economic picture?

DR. PALYI: First, let's be clear about it, there has been a widespread fear or apprehension of a forthcoming recession. Last winter, forecasters, official and private, were practically unanimous in predicting that the first half of the year would be good and the second half would bring reaction. Now it turns out that the first half was better than anyone suggested, and the pessimistic forecasts have been postponed anywhere from three to six months or longer. But the prevalent opinion is still that pretty soon a reaction must set in, and business must fall off. And appearances support that opinion very strongly!

On the other hand, inflationary forces are at work. The number one inflationary force is the money supply, which is growing. On June 30th, end of the mid-year, the country had about $7 billion more deposits and over $1¼ billion more cash in circulation than a year ago, all of which adds up to about a four percent rise of money volume in a year's time. That's quite substantial. And the second half of the year is going to bring even more of a rise. The season for inventory buying is in the second half of the year. That's when bank loans swell.

In addition to this continuous expanding of the money volume, the Federal Reserve has lowered the reserve requirements for member banks which means that they can loan more money—several billions more. The real meaning of this measure is to create bank purchasing power to absorb over a $6 billion deficit the Federal government is likely to run in the second half of 1953. Now the major part of the deficit can only be absorbed by the banks. And as the banks buy Federal securities, they put bank balances at the government's disposal, which in turn spends them. There is an example of a straightforward inflationary force in operation.

Will the expected round of wage increases add to inflationary pressure?

DR. PALYI: Why most certainly! In fact, wage increases are the force that boosts prices. This year's wage round will be moderate in comparison with past post-war years, probably something like seven or eight cents per hour on the average. But still it adds to the cost of production which is usually passed on to the consumer.

Is there a limit to which these price increases can be forced on the consumer?

DR. PALYI: Of course price increases cannot be forced on the consumer without limit. That would be runaway inflation.

To put the entire picture into the proper perspective, it is important to mention the forces tending to counteract the inflationary pressures. One of these factors is the falling raw material prices, especially the falling prices of farm products. In spite of all efforts of the Federal government to support the farm price structure, it has been slipping quite a bit this year and it's likely to slip even more. International raw materials, metals, and minerals are marketwise in a weak condition. That's one force upsetting the trend toward rising prices. The strength of the second force will depend on how much of the rising cost due to wage boosts will be absorbed by lower profits. It seems that some of it will have to be absorbed by lower business profits. Third, the most important, is what will the consumer do? Will he accept higher prices or will he be fed up with ever rising prices for manufactured products? That's the crucial question of the whole situation.

The present signs are that the consumer is going

to buy, but that doesn't answer anything. The question is what will he do three months hence. I have little doubt that there will be some letdown in business activity during the summer, not more than seasonal in certain industries. But with the terrific volume of sales over the last six or seven years, you can never tell at which point the consumer may feel that he has built up his larder and stops buying. Of course it's always possible that new products will give new impetus to consumer buying. Furthermore, it is possible for the consumer to go on a buying spree. Since our population increases by three million or so a year, that alone may maintain a growing demand. But it's all a matter of proportion. How much does demand grow in proportion to the tremendously growing supply? And bear in mind that because of the vast volume of capital investment in productive channels since the war, the supply capacity has greatly increased.

Would a falling off of the armament program have any effect on the inflationary pressures?

DR. PALYI: The answer is "yes" if it would drop off, but don't expect any such drop in the armaments program. It will continue to run at the $50 billion annual rate or more. I expect, in fact, a rising volume of armament expenditures.

Will pending tax-reduction measures, if effected, decrease inflation pressures?

DR. PALYI: Tax reduction works both ways, and it is difficult to predict which way it will turn. It is claimed that tax reduction means that the government has less money to spend and the taxpayer has more to spend. The likelihood is that the taxpayer does not spend his money as rapidly as the government does and therefore a tax reduction is likely to act temporarily as a deflationary rather than an inflationary measure.

Can a foreign market take up any of the slack in consumer demand?

DR. PALYI: The answer is "yes" if you give it away free of charge; "no" if you don't give it away or if you want a reasonable price for it. In farm products, in particular, the export market is very severely hit by several factors. First, are the restrictions put in the way by foreign governments on account of the dollar shortage? Another is the favorable crop situation in many parts of the world competing with ours, especially in Canada and Argentina. There is also growing competition for American products in cotton and tobacco. South Rhodesian tobacco threatens to displace Virginian in the lush British market, one of the world's biggest after the American. From every side the farm situation is under great deflationary pressure.

And the industrial picture is not much brighter. Again for reasons of dollar shortage, trade restrictions and industrial recovery abroad, the U.S. is finding increasing competition in the world markets from Germany, Japan, France, and England, among others.

Will the deflationary farm pressure be reflected in lower productivity factors in industry?

DR. PALYI: Not much. Truck sales decline partly because farmers buy fewer trucks. Their lower income this year and the prospect of lower farm income next year will affect the sale of farm appliances. But let's not forget that any reduction in the cost of food, cotton, and other agricultural commodities strengthens the purchasing power of the urban population of America which is, after all, 80% or better of the total. Therefore, while the farmer may buy less, the urbanite can buy more.

What are the dangers in continued corporation and individual credit expansion?

DR. PALYI: Our present credit expansion is built like an inverse pyramid. The bottom is narrow and the top is wide which makes it top-heavy, and therein lies the real financial problem of this whole thing. As long as the Federal Reserve goes on adding a billion—the last 12 months a billion seven hundred million—to the credit, and the banks add $7 billion of deposits to their volume of money at the public's disposal, and the public adds some thirty billions of private debt on top of that . . . well, it's fine as long as it goes that way!

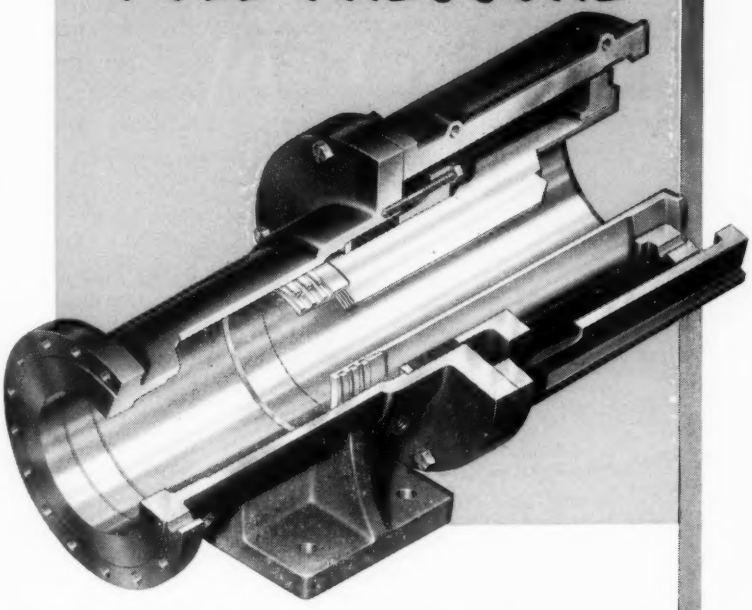
In other words, this is the kind of credit expansion, or boom based on credit expansion and fed by credit expansion, which is bound to come to an end, or at least to a slowdown and a stoppage at some point. When the credit expansion and the debt expansion of corporations and individuals and municipalities was reduced in 1949 by some $5 billion, remember we had a sort of recession, a little one, but nevertheless a recession. We can have a much bigger recession on the very same grounds in '54 or '55 or '56.

If there were to be a recession, what can the government do to cushion the shock?

DR. PALYI: The trouble is that the government is stepping in all the time right now. The real shock will come at the point when the Federal government cannot step in any longer without endangering the dollar. We have taken too much advantage of that poor fellow called the dollar, stretching it no end. But there is a point where the government cannot raise additional taxes and can't expand its debt without printing money on a substantial scale. Let's hope we don't get to that point and instead have a slowdown before then. If we slow down in time, as long as the credit of the Federal government is not over-extended, as long as it can get funds without printing money on a large scale, that long any recession or depression can be well controlled and kept within limits.

ADSCO EXPANSION JOINTS...

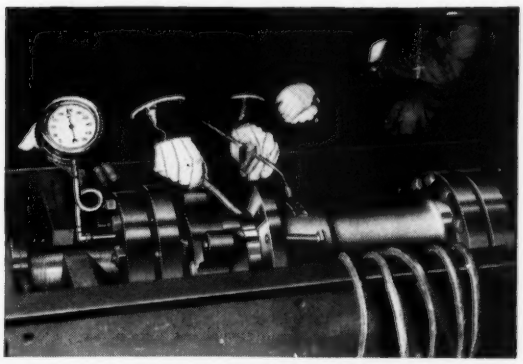
UNPACKED AT FULL PRESSURE



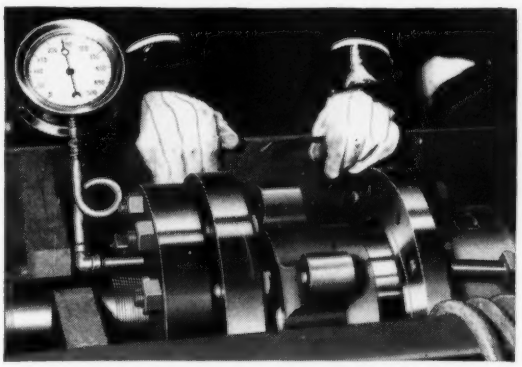
▶ ADSCO piston-ring expansion joints can be serviced . . . in fact, unpacked and repacked . . . under full line pressure. There is no interruption of service, no down-time for repacking, because the job is done under normal working conditions.

▶ Yet this isn't the only great feature of this high-quality joint. Slip is completely guided . . . split external guide permits smaller manholes . . . limit stops prevent over-travel of slip . . . polished surface cannot be scored because slip is in contact with packing only . . . misalignment is prevented by both internal and external guiding. ADSCO piston-ring expansion joints are available in a full range of sizes, with 4", 8", or 12" traverse per slip, for pressures to 400 psi and greater and for temperatures to 800F and higher. Call an ADSCO representative or write for Bulletin 35-15H.

. . . and here's proof



Last strand of packing being withdrawn from stuffing box.



Close-up photograph shows all packing removed. With steam at 240 lbs. pressure and with 300° superheat there is no trace of steam in the empty stuffing box.

With periodic adjustments of the gland, it may never be necessary to repack the stuffing box in an ADSCO piston-ring expansion joint. However, lack of maintenance may make it necessary at some time to do so and the job is easy with this ADSCO joint. The piston rings hold the line pressure during the unpacking and repacking operation. With the vent valve open, the vent chamber is at atmospheric pressure and, under this condition, no steam can enter the stuffing box space. Thus complete repacking can be done under full line pressure.

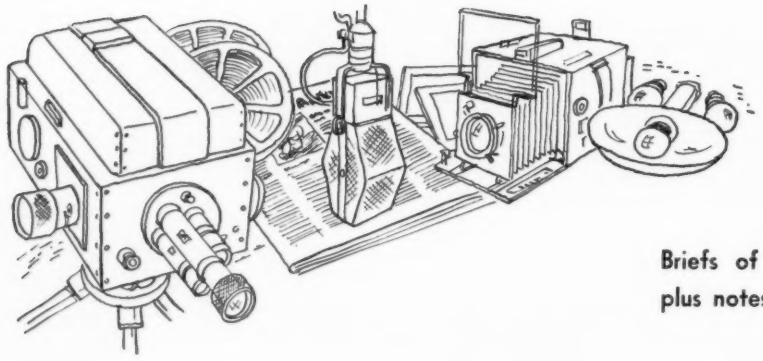
ADSCO ENGINEERED PRODUCTS

EXPANSION JOINTS
HEAT EXCHANGERS
STEAM TRAPS
STRAINERS
SEPARATORS
METERS

AMERICAN DISTRICT STEAM COMPANY, INC.

NORTH TONAWANDA, NEW YORK

Since 1877



NEWS

Briefs of current interest to the consulting profession plus notes on new equipment in the field of engineering

New Preparation Plant Begins Operation

Savings and increased efficiency that come from well-prepared, high-Btu bituminous coal are enabling many industrial coal consumers to successfully combat high fuel costs resulting from high freight rates and expensive handling. Numbered among the many preparation plants now under construction, or beginning initial operation, is the plant for the Williams Mine of Consolidation Coal Co., a division of Pittsburgh Consolidation Coal Co. The plant, beginning operation this month, is expected to develop rapidly into one of the largest and most efficient coal operations in the Fairmont, W. Va. area.

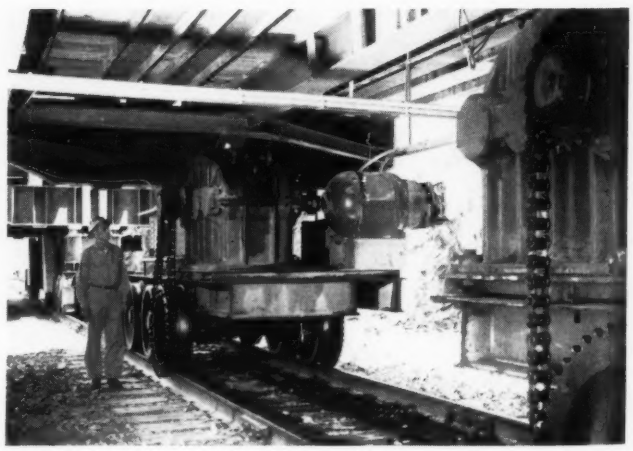
The new plant will be the first Pittsburgh Seam operation in the Fairmont region to wet wash all sizes of coal, and provide thermal drying of fine sizes. Daily plant capacity will be 8500 tons of washed coal, with provisions for expansion to 15,000 tons per day when required.

Located in Harrison County, not far from Fairmont, the Williams plant is situated on the Bingamon Creek branch of the Western Maryland Railway. In addition, it is also served by the Baltimore & Ohio Railroad.

Designed and built by the Fairmont Machinery Co., the plant has a number of unusual features. Unlike any other Pittsburgh Seam operation in this region, two distinct types of wet washing equipment are employed. Thermal drying is used on the fine sizes, in addition to centrifugal drying and normal de-watering screens.

Liberal space and design provisions have been built into the plant for expansion, including the addition of a second Chance Cone, additional Deister tables, and additional centrifugal and thermal drying equipment. Employees refer to the plant as the "Williams Windowless Wonder," because of the enclosed modern design. The plant is housed in a steel and concrete structure, which reaches 100 ft. above ground. Included is a vacuum dust collection and ventilating system, and fluorescent lighting. All major operating levels are served by a special elevator and by a loud speaker system.

Coal is brought into the plant from the bottom of the slope by means of a 48 in. raw coal belt conveyor. Under current schedules of capacity operation, coal can be fed into the plant at the rate of 450 tons per hour to provide a yield of 412 tons of cleaned, prepared coal.



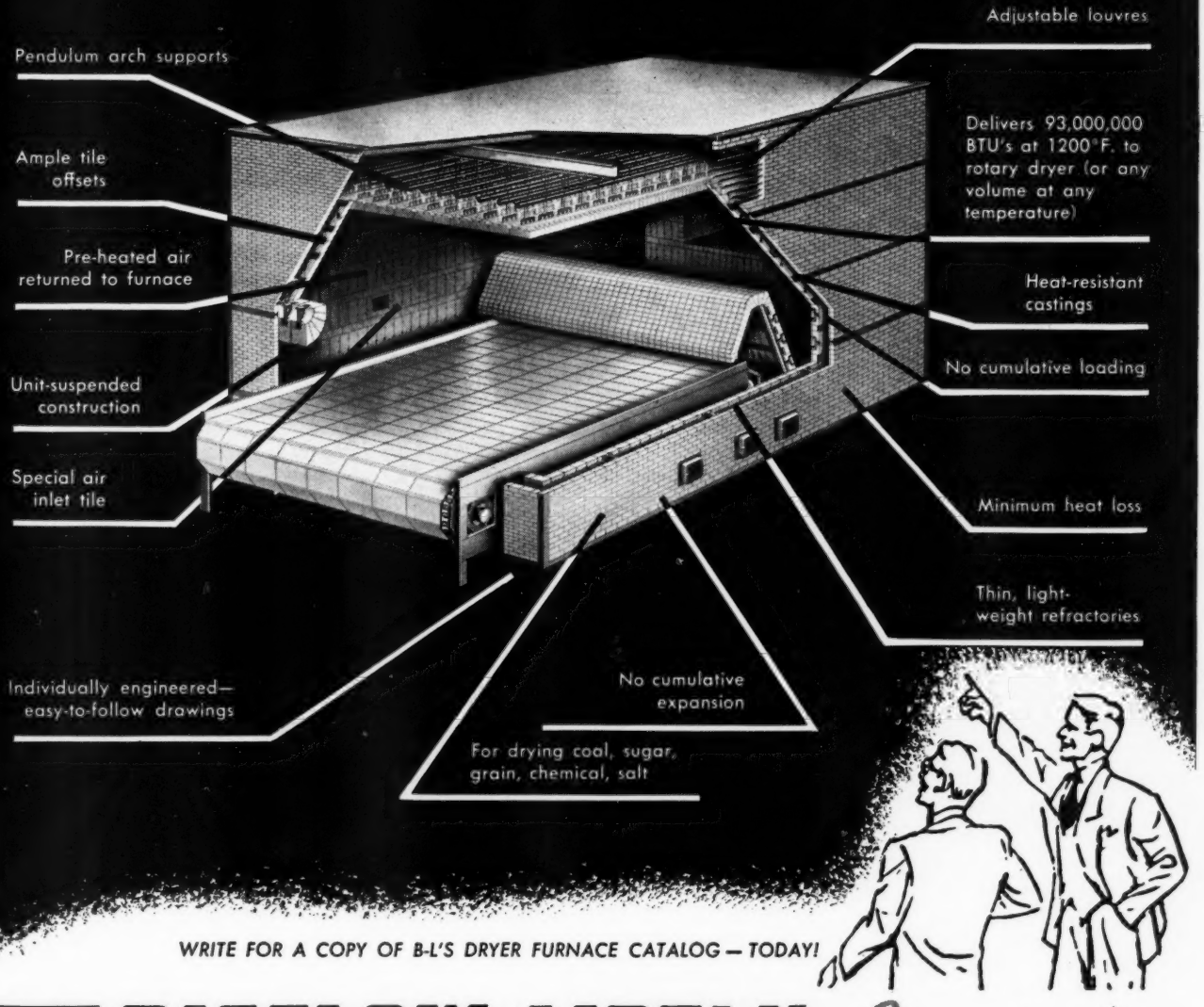
Cableway Sets New Records For Placing Concrete

New records were established for placing concrete during the construction of Pine Flat Dam across California's Kings River. The massive dam, 30 miles northeast of Fresno, Cal., is now nearing completion with construction from six to eight months ahead of schedule.

Powered and controlled by General Electric equipment, the record-breaking cableway operated at a maximum rope speed of more than 2000 fpm

(Continued on page 54)

Look at all the advantages of B-L THIN WALL *construction for Coal Dryer Furnaces*


Adjustable louvres
Pendulum arch supports
Delivers 93,000,000 BTU's at 1200°F. to rotary dryer (or any volume at any temperature)
Ample tile offsets
Pre-heated air returned to furnace
Heat-resistant castings
No cumulative loading
Unit-suspended construction
Special air inlet tile
Minimum heat loss
Thin, light-weight refractories
Individually engineered—easy-to-follow drawings
No cumulative expansion
For drying coal, sugar, grain, chemical, salt

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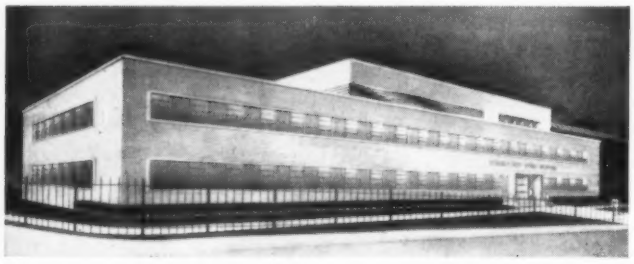
Cableway Sets New Records

— *Starts on page 52*

over the 2400 ft span between its head and tail towers. Utilizing an 8-yd bucket containing 17½ tons of 50-degree concrete, the cableway accurately placed more than 4000 cu yd of the material in one 24 hr period. High speed of the record-making cableway, nearly twice that of conventional rigs, was made possible by the use of d-c power, separate drives which enable it to hoist and haul simultaneously, and an amplidyne control system for positive operation.

Separate amplidyne-controlled, adjustable-speed drives operate the hoist and haul drums. Each drive consists of two 400 hp d-c motors, which receive power from an MG set made up of two 300 kw shunt-wound generators driven by a 900 hp synchronous motor. The main-drive motor features two-shoe, magnetic braking.

Pine Flat Dam will use its entire reservoir storage of 1 million acre feet to control the flood waters of the Kings River. In addition, the 440 ft dam—eighth highest in the world—will use its conservation storage at the end of the flood season for irrigation and the development of hydroelectric power.



Industrial Hospital to Serve Three-Fold Purpose

One of the most modern industrial hospitals in American industry is being erected by General Electric Co. to minister to the needs of its 41,000 employees in Schenectady. The million dollar hospital is being constructed to serve a three-fold purpose. It will give emergency treatment for ill or injured employees, it will expedite pre-placement and other types of examinations, and it will provide an industrial hygiene laboratory to study working environments and industrial hazards.

Architectural work for the new facility is being handled by York & Sawyer, of New York City. General contracter is James E. Lowe & Sons, Inc., of Schenectady. The hospital will be a two-story, brick-faced reinforced concrete, structural frame building with a penthouse to accommodate equipment for air-conditioning and other services. Gross floor area totals 33,600 sq. ft.

An industrial hygiene laboratory will be provided to conduct a continuous investigation of working conditions with respect to solvents, acids, dusts, airborne contaminants, humidity, noise, illumination, and conditions involved in welding and other processes. The laboratory, along with facilities for giving physical examinations to prospective employees, will be housed in the second floor.

New Space Heater Design Permits Easy Maintenance

Incorporated in suspended space heaters, developed by the Heating Dept. of the Machinery Div., Dravo Corp., is a cast iron Bunsen type burner assembly which can be removed quickly for servicing and cleaning. The door frame slides out with the mounted burners and all controls, making them easily accessible.

Units are suitable for natural, manufactured, mixed, liquid petroleum, sewage, or coke oven gas, and are available with input capacities ranging from 85,000 to 215,000 Btu per hour. Units are available with a standard fan, a squirrel-cage blower for short duct runs, or without a blower for use as a heating unit to be built directly into air-conditioning duct systems.

Process Converts Coal To Gas in One Step

Pulverized coal is converted to synthesis gas in one step by a new process known as coal-partial-combustion. The gas, a mixture of carbon monoxide and hydrogen, is the base of over 100 of the world's most important chemicals.

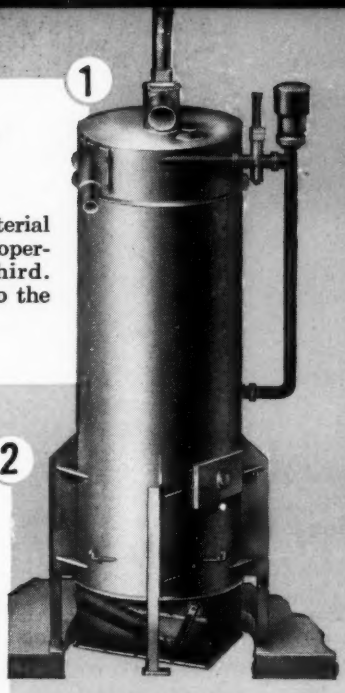
The first pilot plant for using the new gasifying process was built by The Babcock & Wilcox Co. for the Bureau of Mines, and went into operation at Morgantown, W. Va. in the summer of 1951. It burned about 500 lb per hr of coal, and produced 330,000 cu ft of carbon monoxide and hydrogen gas per day. Next, a larger size, semi-scale plant was built for E. I. du Pont de Nemours & Co., and was

(Continued on page 56)

How much can these new DUST-handling developments save your plant?

1 Continuous Vacuum Collector

Collects and dumps material simultaneously, cutting operating time by one-third. Carry-over is reduced to the vanishing point.



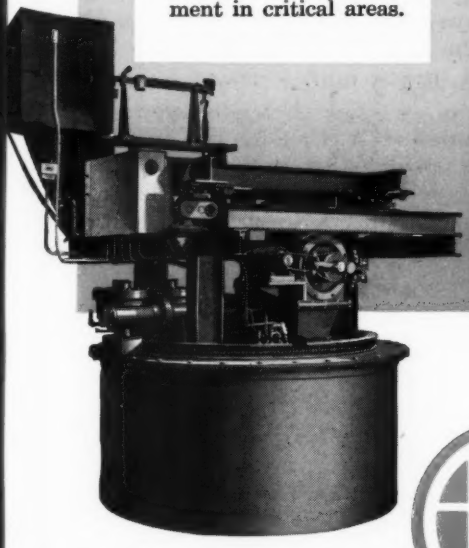
2 Batch Type Dust Conditioner

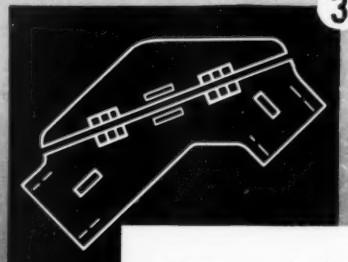
Eliminates dust nuisance during unloading. Automatic operation insures uniform results and ideal end product. A wise investment in critical areas.

4 Automatic Sequence Head

All system components are controlled by a single master switch. By assuring maximum loading of the transporting air, it gives top efficiency and minimum wear.

You can count on A-S-H to pioneer in modern disposal methods





3 Impact Fittings with Removable Wearbacks

A complete line of fittings, designed with all joints machined in a single plane. Plastic filler is not needed, and joints maintain their tightness. Wearbacks are interchangeable and are reversible for double life.

These are just a few of the many new components that A-S-H engineers have developed to reduce disposal costs while making cleaner plants. Let these men help you streamline your present system or design a new one for you from scratch. Send today for Catalogs 652 and 752.

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HYDROJET (hydraulic) HYDROVAC (pneumatic)

materials handling systems

Coal to Gas in One Step

— *Starts on page 54*

placed in operation at their Belle, W. Va. works in the fall of 1951. This plant converted 3000 lb per hr of coal into gas, producing in excess of 2 million cu ft per day.

As a result of these earlier experiences, du Pont has decided to build a full-scale plant. Cost of the new unit, plus dismantling portions of the gas-generating equipment and coking ovens which it will replace, will cost more than $4 million. The new facility will be built by Babcock & Wilcox.

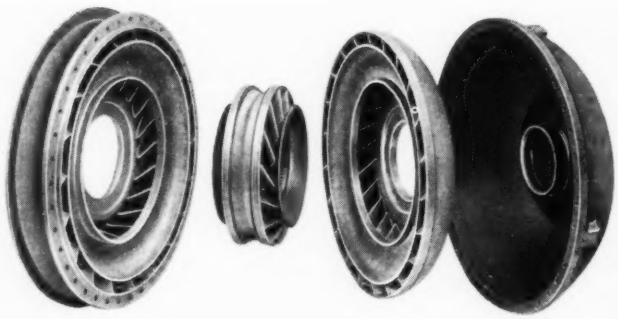
In the new process, low-fusion-ash coal, instead of less plentiful coking varieties, will be crushed and reduced to the fineness of talcum powder. It will then be blown into a refractory lined furnace, where, at carefully controlled temperatures, the volatile matter and fixed carbon will be burned in the presence of steam and a deficiency of oxygen to give carbon monoxide and hydrogen. Carbon monoxide, except as used in the manufacture of ethylene glycol and certain other products, will be reacted with steam to give hydrogen and carbon dioxide, which are readily separated. Hydrogen and nitrogen, the latter obtained in the production of oxygen from the air in separate equipment, will be used in making ammonia.

The bulk of the ash will be drawn off as slag. Lightweight particles will be caught in filtering equipment. The plant will utilize heat given off in this process to produce steam for other purposes.

By permitting the use of lower grade coals, the new process will lend itself to operation in widely diversified locations, instead of only near beds of high grade coal.

Transparent Drafting Stamp Made of Acrylic Plastic

Transparent plastic used in a new draftsman's stamp, developed by John Griffin Co. for stamping conventional symbols on engineering drawings, permits the user to orient a symbol with existing lines on a drawing. The embossed printing section is a flexible pad cemented to the acrylic block. Units are available in 124 different engineering symbols, designed in accordance with ASA standards. Each stamp is 1¼ in. square and 5/16 in. thick. They are being marketed in kit form, each kit containing 27 stamps, a plastic case, two ink pads, and ink.



Hydraulic Torque Converters Provide Smooth Operation

For use with high-torque, medium-speed engines from 325 to more than 1000 hp, The National Supply Co. has developed a new hydraulic torque converter. The unit lengthens the life of both engine and driven equipment since it acts as a cushion to smooth the flow of power and prevent transmission of shock and vibration in either direction.

Performance characteristics and heavy-duty design are provided to meet service conditions of many industrial applications where inherent smoothness of a hydraulic drive is advantageous in handling continuously fluctuating loads, or to start and accelerate heavy loads repeatedly. Such service conditions are encountered in power shovels, hoists, cranes, switching locomotives, logging equipment, and well drilling rigs. In this type of service, engines can operate at peak performance without lugging, since the converter automatically varies outlet speed and torque multiplication instantly as the load changes.

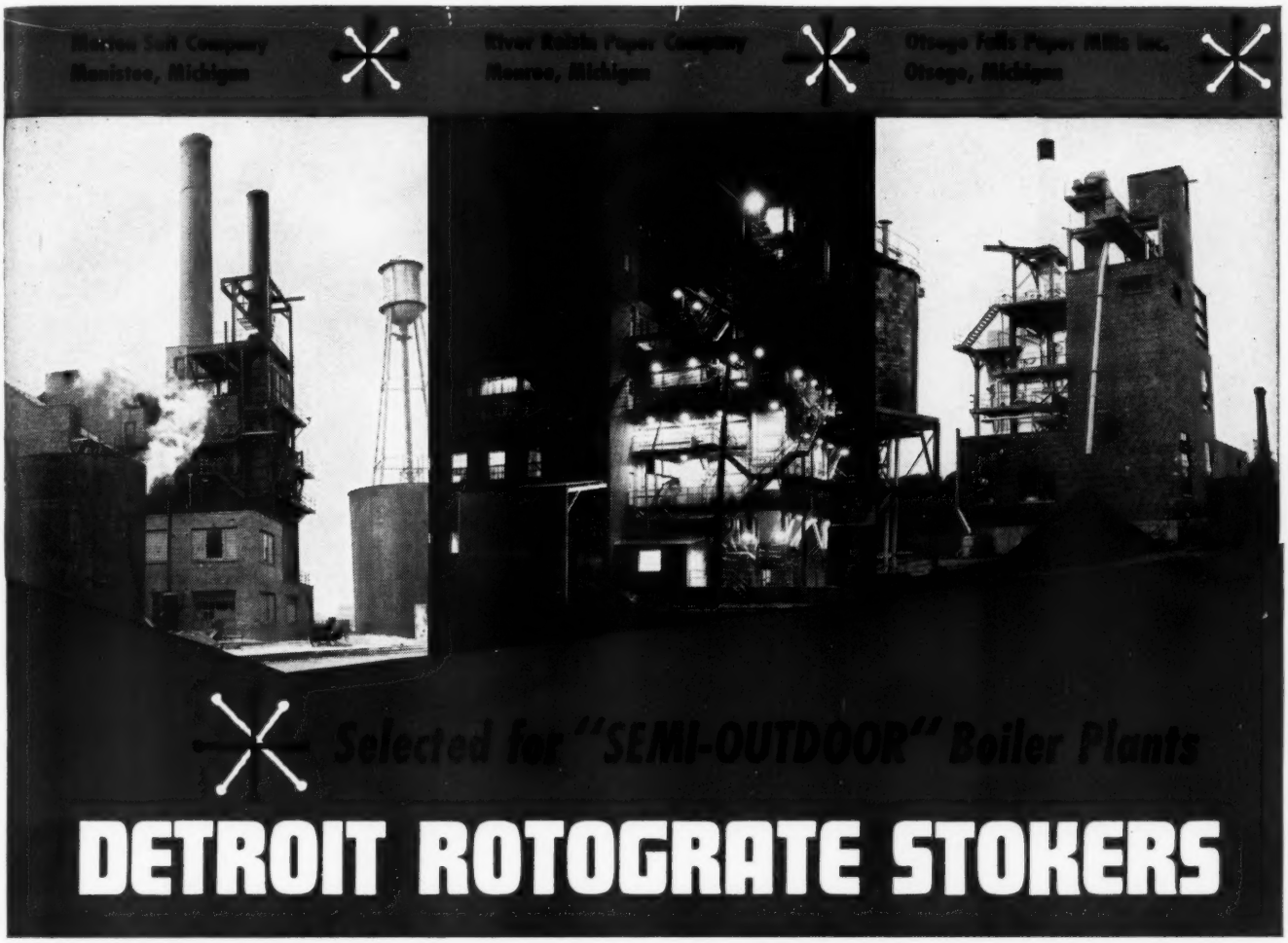
Units are mounted on a standard No. 00 flywheel housing, and add only 36½ in. to the over-all length of the engine. Operating members of the converter, shown in the illustration, are the driving member or pump (left), the stator (center), and the driven member or turbine (right).

Bayonne Constructs New Sewage Facility

Worthington Corp. reports that it has been awarded a contract to supply the bulk of the pumping equipment for a new $9 million sewage treatment plant now being constructed by the City of Bayonne, N. J. The plant, when placed in operation toward the end of 1954, will have a capacity of 20 million gallons per day.

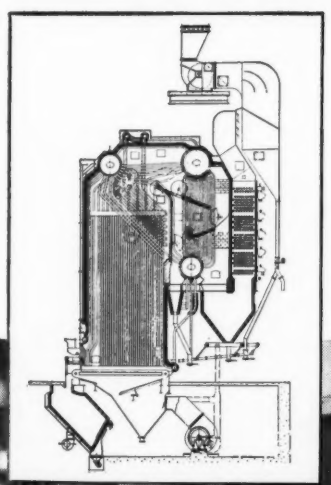
Units at the treatment plant will include: two 10 mgd and four 20 mgd vertical raw sewage pumps driven by gas engine through right angle gears; two 500 gpm vertical sludge pumps; three 200 gpm ver-

(Continued on page 58)



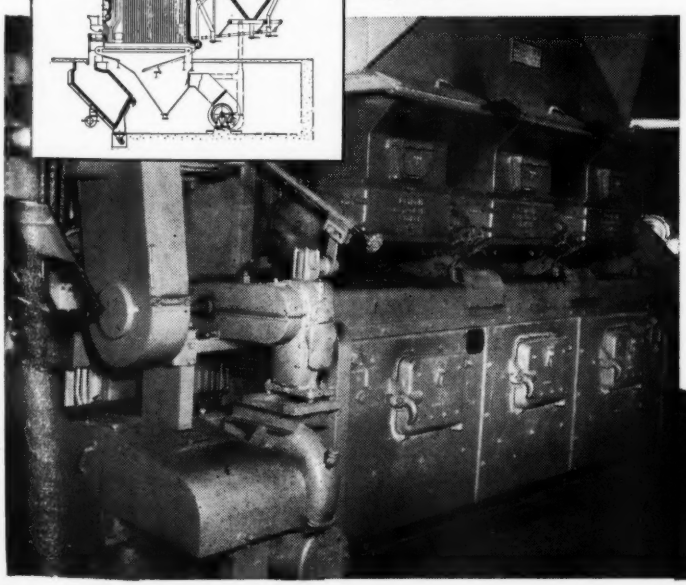
Selected for "SEMI-OUTDOOR" Boiler Plants

DETROIT ROTOGRATE STOKERS



AT OTSEGO

75,000 pound unit with superheater and economizer. 650 pounds pressure 750° F steam temperature. Based on Ohio Strip Mine coal—10,800 BTU.



Savings in building structure costs are substantial. May run as high as 15% of the total investment in the boiler, stoker and accessories, according to Cummins & Barnard Inc., Consulting Engineers, Ann Arbor, Michigan.

Here are representative RotoGrate "semi-outdoor" installations made under the direction of these Engineers.

Detroit RotoGrate Stokers

- **Provide More Capacity**
- **With High Thermal Efficiency**
- **Readily Applied**
- **Burn Wide Range of Fuel**
- **Exceptionally Dependable**
- **Reduce Steam Costs**
- **Maintenance Low**

Investigate now.
No obligation—write:

DETROIT STOKERS

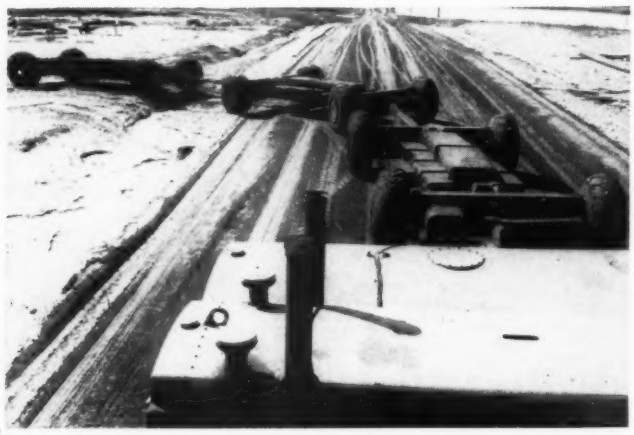
DETROIT STOKER COMPANY

Bayonne Builds New Sewage Plant

— *Starts on page 56*

tical clarified affluent pumps; and three engine-starting air compressors.

In addition to the treatment plant, the project includes a pumping station on the west side of the city. Sewage will be intercepted and pumped across the city to the treatment plant. For the pumping station, Worthington will provide four raw sewage pumps, each with a capacity of 6 mgd.



Trackless Train Provides Transportation in Undeveloped Areas

Many interesting applications in undeveloped areas are suggested by a rubber-tired locomotive and freight car combination developed by R. G. LeTourneau, Inc. Known as the Tournatrain, it is designed for economical operation over pathless desert sands or over cheaply constructed roads.

Heart of the train is an electric wheel, which consists of a large pneumatic tire having an electric motor and gear reduction within its rim. Every wheel of the train is a rubber-tired, self propelled wheel, deriving its energy from the locomotive which mounts diesel engine-driven electric generators. From his cab on the locomotive, the engineer applies power at will to all wheels of the Tournatrain. In this way, each freight car provides propulsion for its own load, and pushes and pulls at the same time.

Each car is coupled to the car ahead of it in such a way that it follows in the same tracks. By a simple automatic steering device, the path of the locomotive is duplicated in its turn by each car of the train.

With the combination of electric self-propulsion in every wheel, large diameter and wide based tires providing flotation over sand and bog, and each car tracking the one in front of it, the trackless train is expected to become a trail blazer for cargo transportation in undeveloped areas. This modern engineering feat suggests a trackless train carrying passengers and cargo north and south across the vast North African deserts, or perhaps transportation to the interior of continents such as Africa and South America over bulldozer trails.

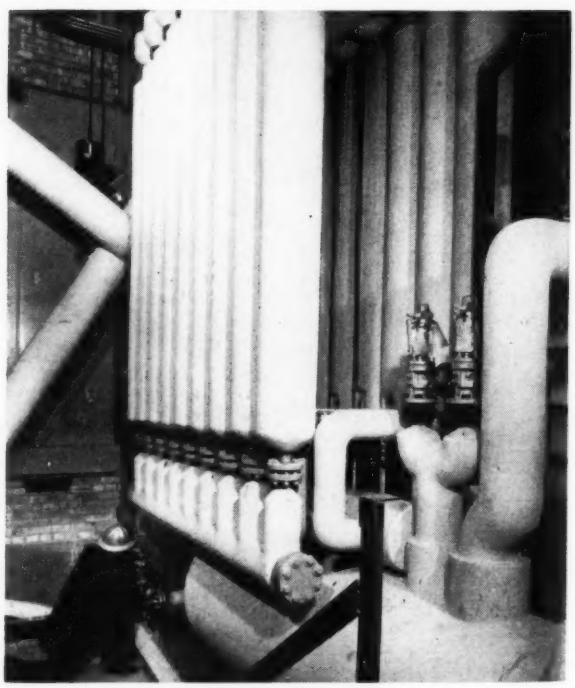
Lignite Will Be Power Source For New Aluminum Smelting Plant

Lignite will be used as a major power source for the new Rockdale, Texas smelting plant of Aluminum Company of America. This will constitute the first use of lignite for industrial power production on such a scale.

Extensive drying facilities will be constructed by The Rust Engineering Co. to supply dried lignite to three large steam generators in the new Sandow Power Plant, now under construction. Dryer units, in groups of three, are scheduled for completion a month apart, with the final group to be ready for operation towards the end of the year.

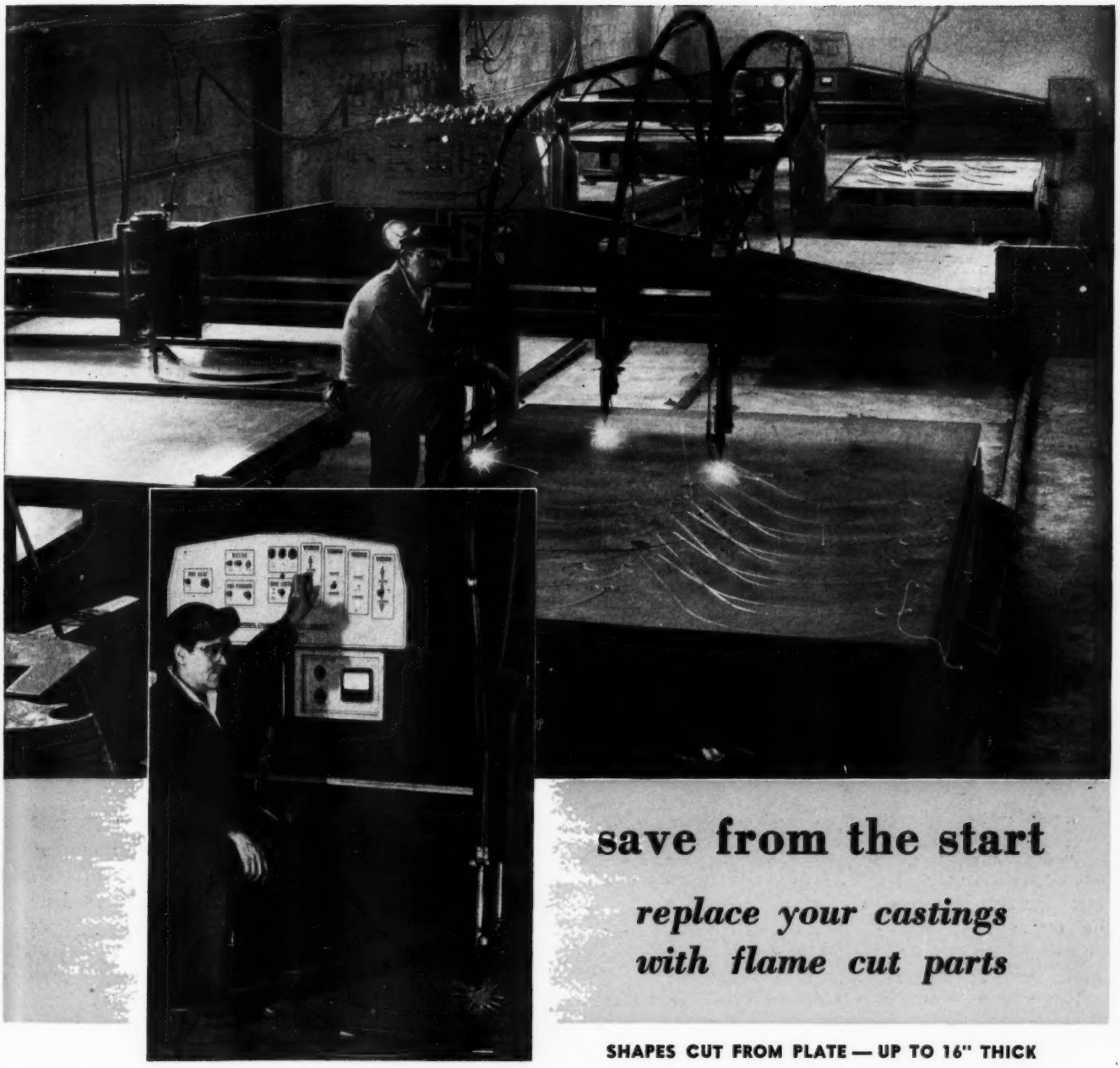
Although considered a cheap fuel pricewise, industry has found lignite hard to utilize efficiently since it is a "green" coal, is difficult to store, and its heating value is only about half that of bituminous coal. However, a new drying and carbonizing process developed by the Bureau of Mines at its Denver, Colo. laboratories in cooperation with the Texas Power and Light Co., raises the heating value of the char to about 11,000 Btu.

Pending completion of the new power plant, the Rockdale Works is partially in operation on power supplied by the Texas Power and Light Co. Alcoa expects to produce about 85,000 tons of aluminum annually at this plant, by smelting of alumina from its bauxite ore processing plant in Arkansas.



ATOMIC STEAM GENERATOR

Argonne National Laboratory developed this steam generator for use with its Experimental Breeder Reactor. The unit differs in appearance, and in some respects in construction, from conventional steam-producing systems. Design features prevent the reactor's alkali metal coolant from mixing with the water and steam, since contact would produce a violent reaction. Steam conditions, after passing through a superheater, are 550 F and 400 psi.



save from the start

replace your castings with flame cut parts

SHAPES CUT FROM PLATE — UP TO 16" THICK

If your casting has two flat sides and a perpendicular edge in almost any shape, it can be cut out of steel plate by FOSTER. Flame cut parts are better than castings in some applications because they are lighter in weight, easier to machine, have greater strength, and cost less money. Shown above is a group of National Cylinder Gas flame cutting machines in operation. By using such modern equipment, FOSTER is able to mass produce shape cut parts at reasonable prices. Sometimes a casting can be replaced by a weldment. Two or more parts cut from steel plate and welded together may often present a considerable saving over a similar casting. Any reasonable shape from 1" square to 8 square feet can be cut by FOSTER — to your exact specifications.

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to be carefully recorded. Obviously, the property record must be flexible so that it can be kept alive and up-to-date through the recording of property additions, deductions, and transfers. Remaining useful lives will need to be re-examined and adjusted from time to time. The existence, condition, and location of the property units will need to be checked periodically. If this is not done, serious shortages in the property accounts may develop.

It is very doubtful, of course, that anyone could "walk off" with a milling machine, yet through inadequate property control it is often found that important and costly machines are carried on the property records long after they have been removed and traded in or sold to the junk dealer.

A good property deserves a good property record.

The time to set up that record is when the plant is new. At that time cost data are available and group costs may be analyzed and identified with or allocated to specific units or classifications. Detailed descriptions of the units may be prepared which will be invaluable in future years for accounting and administrative purposes and to determine the then current values of those assets for insurance purposes.

To assure flexibility and adequate control, it is recommended that the record be set up in looseleaf plant ledger form, on filing cards, or on tabulating cards. A property record so prepared may be kept up-to-date through the preparation of a new card for each unit added, the removal of the card for items sold or scrapped, and the transfer of the card to reflect the physical transfer of a unit from one department or plant to another.

Although cost is cost for accounting and income tax purposes, it by no means follows that cost is "actual cash value" for insurance purposes—even on a new plant.

Standard insurance coverage is based on the "normal" replacement cost of the property less an allowance for accrued depreciation, and frequently less certain specified exclusions such as excavations, footings, and foundations. During recent years, many plants have been erected under anything but normal conditions. In order to handle urgent orders, the plant may have been erected under extreme pressure. In order to hasten completion, premiums may have been paid for prompt delivery of materials and equipment, and substantial overtime may have been paid to labor. Justifiable as these added costs may have been because of exigencies at the time, they are not recognized by insurance companies in determining the normal replacement cost which is the basis upon which "actual cash value" is determined. Furthermore, if the abnormal base is used for the application of future price trends, the result will be likewise distorted. Certainly for insurance purposes it is well to determine and recognize the excess costs involved in the erection of the plant.

It is seldom that the cost records will provide a proper basis for segregating the value of the assets covered by insurance from the value of those items specifically excluded from coverage. It may also be impossible from the cost records to segregate the items defined as "Buildings" in the insurance form from those defined as "Contents." It is important that this segregation be properly made as the building rate is usually much lower than the contents rate. It is also important to segregate the insurable values by insurance "risks," which usually means by buildings.

When a new building is erected, it is often found that the record of "cost" covers such expenditures as the demolition of an old building, the cost of grading and preparing the site, yard paving and walks, underground sewer and service lines, which, although they comprise a legitimate part of the cost of the enterprise, have no bearing on the cost of reproduction of the building itself and which must, therefore, be eliminated in arriving at the insurable value of the building.

These problems in connection with the erection of a new plant may all be resolved through a proper appraisal approach.

Plant Modernization

When an extensive plant modernization program is undertaken, your client will inevitably be confronted with difficult accounting and insurance problems.

The insurance problem involves an inventory of the property after the modernization program is completed and the determination of the current values of the items comprising the modernized plant.

It may be observed that this value will probably have little relation to actual cost.

The accounting problem with respect to retirements involves the determination of the original costs and dates of acquisition of the property torn out and disposed of and the depreciation which has been allowed on those assets to date of retirement. If these costs and reserve items can be proven, they may constitute a proper basis for a claim for loss for income tax purposes. The problem is to establish the facts. If detailed property records have been kept, they will prove helpful in establishing the costs of machine units and other major items removed. But the determination of the cost of the general classifications of equipment and of portions of building structures removed usually requires an allocation of original costs based on an appraisal. If the records have been poorly kept, an allocation of original costs on the basis of an appraisal analysis will perhaps constitute the best evidence available.

The cost of demolition is usually considered as a legitimate charge against current earnings, but in the course of a modernization program it is usually difficult to segregate the time and cost involved in tearing

out the old from the time and cost involved in constructing and installing the new.

The costs of the property additions are, of course, capital items which should be set up on the property records and subjected to the usual allowable depreciation treatment.

The suggested solution to these problems involves a detailed appraisal of the property before and after the modernization.

The remaining accounting problem involves the determination of the effect of the modernization program on the remaining useful life of the property. For example, a building may have been heavily depreciated on the books at the time the program was inaugurated and may have had a remaining life expectancy of only five or ten years. As a result of the alterations, its life expectancy might be extended to 20 or 25 years. Presumably certain deductions would be made to the original cost basis for the removal of a wall, a roof, partitions, or flooring, and certain additions and betterments would be either capitalized or charged against the depreciation reserve. These additions and deductions would thus result in a changed cost basis for the building. This cost basis divided by the revised remaining life expectancy would establish the periodic depreciation provision for the building.

Relocation of Plant

If your client is planning to abandon his old plant and move his operations to a new one, he will undoubtedly need appraisal service.

If he plans to erect a new plant, he will certainly want to protect himself by having a disinterested appraisal to guide him as to the fair market value and desirability of the site which he contemplates purchasing. Such an appraisal should be based on a study of the physical characteristics of the site, transportation facilities, labor supply, availability of utilities, street improvements, and sale and asking prices of comparable tracts.

If he is considering the purchase of an existing plant, he will need an appraisal to determine the Fair Market Value of the property as a whole including a study of physical conditions of the buildings. He will also need an appraisal on the basis of cost of reproduction and cost of reproduction less depreciation for insurance purposes—particularly after he has moved into the plant and completed his alterations and improvements. He will need that appraisal kept up-to-date so that he may always be protected against the day when a loss may occur.

He will also have some income tax and accounting problems in connection with his purchase of an existing plant. He will very likely pay a lump sum for the purchase of depreciable and non-depreciable assets.

An appraisal will provide him with the proper basis for allocating his purchase price to the various classes or items of property acquired and the appraisal should include a remaining life study of the depreciable assets to determine the periodic depreciation provision to which he is entitled. He will want to start operations at the new location with a clear-cut property record which will serve his purpose through the years for accounting, insurance, and other administrative purposes.

Very often the contemplated move can be foreseen several years prior to the actual transfer of production equipment.

When such is the case it is sometimes feasible to review the old property and determine those units to be moved and those to be scrapped. Of course, it can be assumed that such classifications as "Power Feed Wiring," "Manufacturing Piping," "Office Partitions," and other leasehold improvements would be left at the old plant.

If the accounting records permit, those items or classifications of property to remain can be reviewed, their remaining lives for income tax purposes adjusted, and the annual provision for depreciation calculated accordingly. This would allow permissible charges against current earnings and preclude the necessity of calculating subsequent losses in dismantlements when the move occurs.

Sale of Old Plant

In connection with the disposition of his old plant, he will also be faced with some problems. Unless he has been fortunate enough to have found a buyer, he will have to place his plant on the market. He will need help in establishing a fair asking price. Since industrial plants are not bought and sold every day, it is likely that he cannot readily find a suitable yardstick by which to arrive at the Fair Market Value. Here a firm of appraisers who specializes in the appraisal of industrial properties can render valuable assistance based upon a study of local conditions and the possibilities of converting the property to other uses. Even though there be no record of sales of similar properties, the trained appraiser, through his analytical approach, can arrive at a sound conclusion as to the price at which ownership would be justified.

In the case of machinery, if the move is a distant one, it is probable that at least a part of the machinery will be left behind to be sold on the second-hand market. The appraiser can assist in determining the probable liquidation value of the machinery.

In view of the increasing size and complexity of our industrial plants and the broadening of government relation over business, there is a greater need for detailed property records. A knowledge of total capital expenditures is inadequate for the needs of management. Those expenditures need to be carefully analyzed, classified, and allocated to individual items of property, for accounting, insurance, and other purposes. A competent firm of appraisal engineers is prepared, by experience and training, to cope with these problems.

all the primary layouts completed. At this point, the firm discovered that its staff was so busy with work already in progress that their own men would not be able to handle this work. To prevent delay of the project, the firm decided to subcontract primary layout work to an outside organization which specializes in drafting, detailing, and tracing. Such a procedure was possible because process diagrams and flow sheets had been worked out, and drafting standards had been established.

The first step of the subcontracting firm was to redraw the three different plans of the existing structure's ground floor to the same scale on a single sheet of paper, so that all symbols matched. With the proper controls, this became strictly a drafting problem — one that could be handled without guidance from the architect or engineer. Once this was done, it was possible to select existing equipment to be used in the new project, and use this as a basis for positioning new equipment that had been specified.

The project involved a six story building. Working from the revised floor plan of the existing structure, the new and existing sections were developed story by story for both elevation and floor plan. At this stage, locations of all equipment were established.

Using the drawings as a fundamental plan, it was possible for the subcontracting firm, the architect's staff, and two consulting engineering firms to work on various aspects of the project at the same time. Upon completion, their drawings were returned to the original subcontracting organization to be checked and lettered with the client's title blocks. Since uniform drafting standards had been established, it was impossible to tell that the completed drawings had been made by different firms.

Uniform Standards

The fact that a major portion of the project had been subcontracted is not as important as the fact that adequate controls were established in the beginning. This is an essential point, regardless of whether a project is done by one firm or by several. Clearly defined control with uniform drafting standards can result in increased efficiency of engineering staffs, and in considerable savings in time.

It should be pointed out that such control applies not only to structural projects, but to mechanical design and complicated engineering projects as well.

As a first step in establishing controls, the project should be broken down into its basic elements. This provides an opportunity to design on the basis of rough sketches, which can then be detailed into finished drawings under the supervision of the design engineer in another section of the organization, or by an outside concern.

Whether a project is subcontracted or not, the one remaining essential to a smooth working plan is a complete set of consistent drafting and design standards, rigidly adhered to. Such organization effectively expands an engineering staff by cutting down unnecessary intra-office contact, thus permitting draftsmen to do more work, and allowing engineers more time for important engineering problems.

How drafting and design standards can reduce the need for continual engineer-draftsman contact is well illustrated in a recent case in which a large firm subcontracted drafting and detailing work for an important project. The firm provided the subcontractor with a complete book of standards containing not only drafting standards, but design and manufacturing standards as well. It included all machining, structural, and welding specifications, together with notes on standard shop practices. With this material on hand, it was possible for the draftsmen to detail a complete design without ever having seen or discussed the problem with the design engineer.

Subcontracting

In addition to efficiency within a firm's own office, proper control of a project provides the added advantage of permitting the drafting, detailing, and tracing of projects to be handled by an outside firm when necessary. Many firms subcontract drafting work in the same manner that they subcontract special sections of their engineering or architectural work. Such a procedure, in effect, provides a much larger staff without the headaches or overhead involved in expanding personnel.

The most obvious advantage of subcontracting is to relieve staffs of unusually heavy workloads. There are other advantages, however, which may be just as important. As work load increases, tracers can often be used for detailing work. Detailers may be able to move up to designers, and designers may move another step up the ladder. If these steps are repeated often enough, an engineering firm may find that it does not have a sufficient number of good draftsmen to keep up with the designers.

This is not the time to cut activities, but rather it is a time to take advantage of this situation by upgrading present employees. This permits a higher earning rate, and still allows work to be accomplished by making use of subcontract facilities. By using these facilities, no new overhead is involved and when workload is reduced, there is no necessity of deciding which of several good men must be released.

Another important point is tax consideration. Many states have widely varying unemployment taxes, depending upon the individual firm's employee turnover record. This tax can be kept low by allowing another firm to absorb peaks of operation. In addition, peace is kept in the "office family" by eliminating hirings and firings and continual shifting of work between different departments.

— *Starts on page 44*

spots in the over-all picture is the current loose credit policy. The war has been responsible for the accepted attitude towards credits, for money was secondary to securing an adequate supply of material and labor. The situation developed to the point where credit extensions were actually given to suppliers solely to assure a continued flow of materials.

An immediate remedy of this situation calls for an appraisal of a company's credit and discount policies, the setting up of sound budgets to provide sufficient cash for the normal conversion of receivables and inventory, and projection for sound financing to cover requirements for expansion.

My Clients Business?

Assuming that a client's profits are decreasing or not keeping pace with competitors or there are no plans for the business' future or perhaps there is evidence that the management of this business is not sound, a reasonable person would ask the question, "What, if anything, can be done about the situation?" The answer to this question requires immediate attention and lies in three basic steps:

(1) Make an objective review and evaluation of organization and leadership. This is the hardest step of the three because it involves an evaluation and criticism of the client. What is needed to approach the problem is a fresh outlook, which many businessmen hard pressed for profits, lost in habits, tradition, or personal considerations, cannot call upon. It is essential that any review in this area be based on an over-all picture of the organization covering the basic operations and policies, which is the job overlooked or ignored in every day operations. It is possible for management to do this job internally, however, due to its nature and scope, it is readily conceivable that it can be performed better by an outside consultant.

(2) Determine whether or not the management has a valid means of measuring the results of operations. This job may be done very well internally, however, it is wise in most cases to employ the services of a certified public accountant.

(3) Establish methods for a sound and realistic program of projection and planning. Analyze the individual business picture in light of economic changes. Make the necessary research to determine the nature of company production and its relation to the over-all picture, keeping in mind that one class of production or product is affected quite differently from another and that timing in the increase or decrease of production is extremely important. It would be wise, when the basic nature of the product and the extent production is recognized, to test the business under various conditions: (a) Continuation of the present volume; (b) A substantial increase in volume; (c) A reduction in present volume.

While at first this may appear to be statistical horseplay, if we are realistic and use imagination in evaluating economic conditions and their effects on our product, we will undoubtedly set up areas that will become roadblocks as the projected conditions develop.

It also may be well to ask certain questions.

A. *SALES* (1) Have statistical measurements for such things as quotas, areas, and performance been brought up-to-date to meet present requirements?

(2) Is the Sales Department being required to make its own analysis of statistical data, covering such things as sales, quotas, salesmen's performance, and budgets which should be performed by the Accounting Department and given to the Sales Department as a finished job for their guidance?

(3) Is the approach being made by the Credit Department realistic? This can be determined very easily by evaluating whether or not it is an aid to the Sales Department in formulating programs for the development of marginal customers.

(4) If we have not secured our proper share of volume, can it be traced to the selection of our salesmen? If so, wherein have we erred and how do we plan to correct the situation?

B. *PRODUCTION COSTS* (1) Is there a sound policy regarding materials purchases? Is this policy sufficiently flexible to keep abreast of changes in the market?

(2) Has the company been doing a good job on labor relations, not only on negotiations but the carry through to make the labor contract a sound working agreement?

(3) Is there an ample and effective control over fixed and variable overhead items?

(4) If required, how rapidly can costs be cut? Have the areas for reduction and timing of various costs been analyzed?

C. *FINANCE* (1) Would a review of the expansion program indicate that currently needed working capital is being used to expand the property account?

(2) Do the budgets indicate that the company condition is improving or tightening up?

(3) Have cost requirements in the various areas of sales, production, and other expense been appraised?

(4) Are administrative salaries and dividend programs sound in light of current activities?

(5) If taxes are reduced what will be the effect on the firm; are they prepared to meet the situation?

There are many opportunities in management today, but the achieving of these opportunities rests on the ability to withstand the current daily pressure. The key to the problem is to establish a plan, build a sound organization, and make use of all known management tools.

picture is the Brazilian employers' charge that they are handicapped by the government's stabilization law which grants tenure rights to workers in private industry. This, it is said, results in workers' loss of initiative in the kind of job they do.

Lack of standardization vitally affects volume of production also. For example, electric power in the city of Sao Paulo is on 60 cps; Rio de Janeiro power is on 50 cps. To further complicate matters, electric attachments are not uniform, pipe threads vary, and even railroad car brake systems are not standard.

As a result of specific plant inspection tours, coupled with as much questioning as was practical under the circumstances, many facts on several manufacturing companies were secured in detail. It was also possible to determine which tools of management were needed to obtain the quickest and most effective increase in productivity.

Quality Control

Before considering the specific use of management tools, some of the facts relating to Brazilian industry (and the effects of such tools) must be taken into consideration. For example, only a few industries have established quality control systems or are fully conscious of their importance in the production picture. In most cases, there is little concern with the possible savings that can be effected through such control—savings in handling, in avoiding wasted material, in wasted production labor, and in wasted office work. Even more important, few industrialists realize how quality control can create goodwill among the company's customers. Reasons found for lack of quality control methods at present include:

(a) Lack of competition; industries are established for a limited market and are protected from foreign competition by import regulations.

(b) Poor management practices resulting from lack of knowledge or unwillingness to hire help that might possibly be outside the family circle.

(c) Shortage of capital, limiting the hiring of specialized talent.

Wage Plans

Incentive systems to be found in some plants generally consist of a basic hourly wage and a piece rate. The piece rate may be established directly in money per piece, or the job may be assigned a time value which is paid according to the hourly wage of the worker. In most cases where incentives could be used, it was learned that management had refrained from installing them because of a lack of specific knowledge of such plans.

As far as wage payment plans are concerned, very little consideration is given to differential in base rates for varying degrees of skill. The tool of job evaluation has not been utilized in any form—even to the extent of job ranking. The average wage in Brazil is about $1.15 a day. One of the most unsound theories of many Brazilian industry men (of which, incidentally, they are not aware) is also an "occupational disease" with management men in the United States. This is the theory that wages alone determine costs. As management engineers well know, wages alone do not determine costs—the return for wages paid determines cost!

Management Tools

Certain other management tools upon which United States industry depend are practically unused in Brazil. In the field of cost accounting, little effort is made to determine cost by product or by operation, whereby the degree of profit or loss is known on each product. Foreman training is practically non-existent and, while personnel departments do exist to some extent in Brazil, they are not utilized as they are in the United States.

Materials handling is at the top of the list of management tools in the United States; however, little thought has been given in Brazilian industry to utilization of inexpensive conveyors, pre-positioning of process materials, or to the use of containers which can be moved from work to work station. Since this represents the area where the greatest return is possible in the shortest time with the least effort expended, setting up modern techniques in materials handling could well be one of the first and most important steps in securing increased productivity in Brazil. In this particular area, no large initial investments need be considered to effect greater productivity. In fact, any suggestion of heavy investment in materials handling equipment would be out of line because of the low labor cost at present.

Methods

The most needed tool of management is methods and methods engineering. This term is used broadly to cover plant layout, materials handling, and work simplification. While no large investments can be considered at present in most plants, much can be accomplished through better processing methods which will effect a straight-line flow of work for better plant layout, taking into consideration the best practices of materials handling, and taking into consideration the work place of the individual to minimize the cycle time.

The methods of training or work simplification programs similar to the training-within-industry programs that were carried on in the United States during World War II could probably be utilized effectively in Brazilian industry as part of the modernization program. That modern methods can be used successfully is evident from the experiences of one company visited. This company, a manufacturer of consumer goods, is a good example of a high

producer with lowered costs and high take-home pay.

Following are high-lights of company policies which put this firm well ahead of the average:

(a) Wages—although the base pay is not unusually high, the incentive factor is a liberal one and the take-home pay is just about twice the take-home pay for the average company. The philosophy here is not to pay just enough to get by, but to pay the highest necessary to obtain the best employees.

(b) Discipline and rules — because of the high take-home pay, the company is in a position to enforce rigid discipline rules for absenteeism. Naturally turnover is low since the employee cannot earn comparable pay elsewhere. Rules for absenteeism and tardiness are based on a pro-rata scale. Thus, the third offense costs the employee 20 percent of a day's pay and for every succeeding infraction, 25 percent—up to four hours.

(c) Selection and screening—the company is in a position to do careful screening as there is a backlog of applicants many times greater than is needed at any time.

(d) Layout and methods—the layout of this company uses all the straight-line flow principles of good management in addition to utilizing pre-positioning principles.

The success of instituting industrial engineering techniques in Brazil will be 10 to 20 percent on technical grounds and 80 to 90 percent on selling—just as it is in the United States. By selling is meant selling for wholehearted cooperation—the only method by which management tools can be made ultimately successful.

Editor's Note: Retiring AEC chairman Gordon Dean recently cited Brazil as a country interested in nuclear reactors as a source of power to replace present expensive and limited supplies. (See stories in this issue beginning on cover and on page 28.)

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THIS MAGAZINE IS OUR RECOMMENDATION

Torque and Speed

—*Starts on page 40*

other loads because the wasted power is relatively less. For such applications as fans, centrifugal pumps, and small wind tunnel drives the difficulty in operating to low speeds is not a drawback.

The control device of the drive must have the ability to dissipate heat equal to the maximum slip power. Thus for a fan drive the rating of the heat exchanger on a fluid coupling or the resistor on a wound-rotor motor must equal 15 percent of the full-speed load rating.

There is another relationship which is occasionally significant in adjustable-speed drive applications (and is fundamental in application of induction motors to high-inertia loads). It is that in the process of bringing a load up to full speed, the total integrated slip energy during acceleration equals kinetic energy in the rotating mass of the load.

Avoiding Slip Loss

There are a number of types of adjustable-speed drives which avoid the slip-power loss inherent in the slip-coupling type.

The torque-converter type has been mentioned, but it is not often used for large-power applications, except for the Ward-Leonard electric drive.

Wind tunnel drives present an interesting problem. Speed must be precisely adjustable down to a fairly low value. The full speed is in the low hundreds of rpm which practically eliminates the use of a steam turbine and probably a d-c motor. The horsepower may be in the tens of thousands or more, which argues against a d-c motor and makes the slip-power loss of a conventional slip coupling very expensive. The solution which has been frequently adopted is the Kraemer drive. The motor driving the wind tunnel fan is a conventional wound-rotor motor. The variable-frequency slip power from the rotor is in this case supplied to a variable-speed motor-generator set, and then through a second constant-speed motor-generator set is returned to the a-c power source. This complicated system can be economically justified when the slip-power is a substantial factor and when the precise speed control that is of sufficient importance.

Conclusions

The comparatively simple slip-coupling drives provide a straight-through transmission of torque, and the reduction in speed which can be obtained results in a corresponding loss of energy.

Torque converters are also really speed converters and answer the problem in almost all respects except simplicity and cost.

Reclaiming the slip power wasted by a slip coupling is feasible, but at a cost which is attractive only for special applications.

MEN IN ENGINEERING

★ R. J. Strass, a professional engineer, announces the opening of an office at 225 East Michigan St., Milwaukee, for the practice of consulting and structural engineering.

★ H. G. Burr Co., general consulting engineers, has formed a new Mining Division by consolidating with P. R. Paulick & Associates. Facilities now are complete to handle any size mining job.

★ Sporting a beard that would be the envy of any Indian Sikh, C. L. Raines, member of General Electric's Service Engineering Section, has just returned from a three-months tour of duty at the Bokaro Station of the Damodar Valley Corp., Bihar Province, India. (CE—Mar. '53, p. 64).

★ D. C. Cook, former chairman of the Securities and Exchange Commission, is elected a vice president of the American Gas and Electric Service Corp. and is named assistant to Philip Sporn, president.

★ Pioneer Service & Engineering Co. announces important changes among executive personnel of the Engineering Dept. E. D. Uhlendorf, senior vice president, becomes vice president and consultant. W. C. Drummond, formerly vice president and chief engineer, now is vice president in charge of engineering, succeeding Uhlendorf as active head of engineering activities. N. C. Pearcy, now chief electrical engineer, succeeds Drummond as chief engineer, and H. L. Hoeppner, formerly senior electrical engineer, becomes chief electrical engineer. A. C. Bull, vice president, retires as head of the purchasing section, to take up special assignment. E. V. Cullen assumes Bull's duties as chief purchasing engineer.

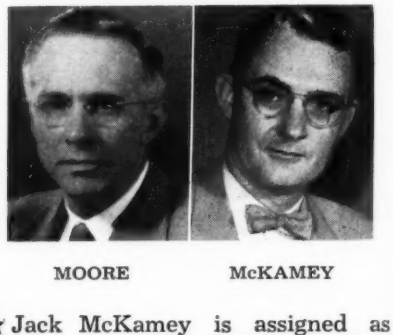
★ Combining almost 40 years' experience in the drafting and engineering supply field, Tom Coatney and Paul Phipps will head up the new sales, advertising, and purchasing offices of the L. L. Ridgway Co., Inc. in Chicago.

VISITING FIREMEN

After a recent New Hampshire electrical conference, a group of committeemen took a tour of G-E's Meter & Instrument Dept. at West Lynn, Mass. M. Princi (left), G-E measurement lab manager, explains the test function of high voltage transformer to F. Salmon, Central Power & Light Co., R. Mighell, G-E Dallas sales specialist, and A. Anderson, G-E Denver sales manager.

★ Appointment of Dr. J. J. Grebe to a new position as director of nuclear research and development for The Dow Chemical Company is announced.

★ W. T. Moore is named an executive assistant in the Atomic Power Div., The Babcock & Wilcox Co. In the Boiler Division, F. X. Gilg is appointed an executive assistant.



MOORE McKAMEY

★ Jack McKamey is assigned as project manager of the Littleton Hydro-electric Development. Ebasco Services is supervising the construction for the Connecticut River Power Co.

★ S. G. Chakrabarti, metallurgical chemist from Calcutta, joins the staff of Sam Tour & Co., Inc. Chakrabarti has been granted an 18-month visa to participate in the Exchange-Visitor program of the U. S. Department of State.

★ H. N. Eaton, recently retired as chief of the Hydraulics Section of the National Bureau of Standards, is retained as a technical consultant to the Research Committee for the Bituminized-Fibre Pipe Industry.

★ H. E. Moses, formerly chief engineer and director of the Pennsylvania bureau of sanitary engineering, took office July 8 as chairman of the Ohio River Valley Water Sanitation Commission.

★ W. H. Wetzel, chief mechanical engineer, assumes the additional responsibility of coordinating design and construction work for National Gypsum Co. Special engineering assignments will be handled by W. A. Schmidt. P. Badame is promoted to field construction superintendent in charge of all construction work and W. V. Sulkowski is now chief draftsman.

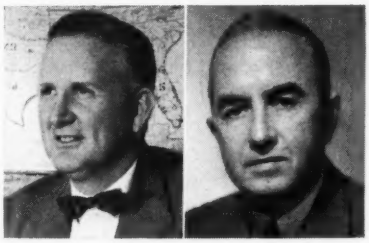
★ J. H. Chiles, Jr., manager of engineering for the Westinghouse Electric Corporation's Transformer Div., is named chairman of the American Standards Association's Sectional Committee C-57 on Transformers, Regulators, and Reactors.

★ K. R. Van Tassel is appointed general manager of the Knolls Atomic Power Laboratory, of the General Electric Co.'s Atomic Products Div.

★ Election of E. B. Robertson, president of Elgin B. Robertson, Inc., as 1953-54 president of the AIEE is announced. Five new vice presidents also were elected—W. B. Morton, Pennsylvania Power and Light Co.; C. P. Almon, Jr., Tennessee Valley Authority; A. S. Anderson, General Electric Co.; G. C. Tenny, Electrical West; and G. D. Floyd, Hydro-Electric Power Commission.

★ L. K. Sillcox, vice chairman of the board of The New York Air Brake Co., is nominated for 1954 president of ASME. Nominated for regional vice presidents are: W. F. Thompson, vice president, Westcott & Mapes; Professor W. G. McLean, head of the Department of Mechanics, Lafayette College; T. Chandler, chemical engineer with Carbide & Carbon Chemical Corp.; V. A. Peterson, district manager for the Elliott Co.; and Professor C. H. Shumaker, director of the Institute of Management, Southern Methodist Univ.

★ C. W. Wright is appointed Administrative assistant to J. B. Cottell, president of Continental Electric Equipment Co. Wright was formerly assistant superintendent in charge of utilities for Delco Products Div., General Motors Corp.



WRIGHT HASKELL

★ B. Haskell, a member of the board of directors and of the executive committee of Combustion Engineering, Inc., is elected vice chairman of the company. Accordingly, Haskell has resigned as a vice president of the Guaranty Trust Co.

★ Dr. F. D. Carvin, director of mechanical engineering at Illinois Institute of Technology, is elected to the executive committee, Chicago section of ASME.

★ H. Knecht, assistant mechanical plant engineer at the Consolidated Edison Co., is elected chairman of the executive committee of the Metropolitan section of ASME.

★ H. D. Luke, for the past five years associated with McKinsey and Co., management consultants, is named department manager of the newly-formed Central Production Planning Department of Reliance Electric and Engineering Co.

★ H. F. Weber joins the Sundberg-Ferar staff as a designer.

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BOOKLETS

NEW YORK INDUSTRIAL MARKET — Statistics in a 66-page handbook entitled, "New York, America's Biggest Industrial Market," show the number of industries located within the area and the number of establishments per industry, as well as number of employees, wages, value added by manufacture, and expenditures. Published for industrial advertisers, the book also points out the extent of wholesale and retail trade, and lists the service industries. In addition, it explains the importance of the executive, buying, and financial offices and headquarters of industrial planners, designers, and engineers located in this area. *Research Dept., The New York Times, Times Square, New York 36, N. Y.*

LABORATORY APPARATUS, including over 800 items of equipment for engineering tests of soils, concrete, and bituminous materials, is described in 72-page catalog 53. The extensive soil testing section presents information on triaxial, consolidation, California bearing ratio, compaction, pore pressure, and all standard apparatus for field and laboratory engineering tests of soils. Also included are sections on general apparatus, ovens, scales, and mixing machines. *Soiltest, Inc., 4520 W. North Ave., Chicago 39, Ill.*

FLEXIBLE METAL HOSE, including helically-wound and helically-corrugated types, are illustrated and described in 52-page catalog 200. Featured in an engineering data section are charts showing frictional losses versus flow rates for various sizes of metal hose and conduit. To provide a better understanding of the make-up of flexible metal hose, construction details and manufacturing methods are presented. Various materials of construction are described for corrosive service. *Titeflex, Inc., 500 Frelinghuysen Ave., Newark 5, N. J.*

VARIABLE SPEED MOTORS and how they are used to improve production are the theme of 16-page brochure 1797. In addition to outlining advantages, the booklet describes design theory and construction features. Special controls, including both mechanical and electrical types, also are discussed. *U. S. Electrical Motors Inc., Box 2058, Los Angeles 54, Cal.*

CONTROLLED VOLUME PUMPS — Design features and construction details of motor-driven controlled volume pumps are appraised in 40-page booklet 553. Technical data include capacity-pressure selection tables, types of capacity adjustments, standard and special designs, and packaged systems. A 2-page chart describes typical applications in six major industries. Also included is a 4-page materials selection chart in four colors. *Milton Roy Co., Station C, 1300 E. Mermaid Lane, Chestnut Hill, Philadelphia 18, Pa.*

INDUSTRIAL SOUND SIGNALS are described in a combination manual, data book, and catalog. Subjects include a simplified explanation of fundamentals of sound, a glossary of signal and sound terms, a quick-comparison guide for selecting signal equipment, suggested steps in choosing a signal installation, and hints for compiling a coding signal call system. Illustrations and descriptions of signal equipment, in-

Personal copies of booklets can be obtained by writing directly to the manufacturers.

cluding howlers, horns, buzzers, and sirens, are presented. Equipment includes special types for industrial, mine, outdoor, and hazardous locations. *Benjamin Electric Mfg. Co. Des Plaines, Ill.*

MONORAIL SYSTEMS for materials handling in various types of industries are described in a series of case study data sheets. Each describes a problem within a specific industry, presents engineering information on the equipment selected, and describes results of the installation. *The American Monorail Co., 13107 Athens Ave., Cleveland 7, Ohio.*

CONCRETE TUNNEL PIPE is presented in 6-page folder IC-L101. The product, which is a pre-cast, reinforced concrete pipe, permits construction of sewers at underground levels without disturbing the surface. In addition to describing methods of installations, the bulletin describes equipment required, presents graphs showing hydraulic properties and discharge capacities, and lists specifications. *American-Marietta Co., 101 E. Ontario St., Chicago 11, Ill.*

CRANES, designed for mobile yard work, are described in 16-page brochure 85. The literature tells how GM Allison torque converters have been adapted to their pneumatic-tired, one-man crane to provide simplified operation and increased efficiency. *Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago 5, Ill.*

PIPE FABRICATION—A detailed description of how pressure piping is fabricated for industrial use is presented in a 16-page brochure. Pictured and described are shop facilities and the steps taken in producing prefabricated piping for the power generation, petroleum refining, pipe line transmission, paper, steel, chemical, and heavy industries. Illustrations show various assemblies being made from carbon and alloy piping, and demonstrate the bending of large-diameter, heavy-wall pipe. *Western Piping Supply Div., The Lummus Co., 504 W. 145th St., East Chicago, Ind.*

INSULATION RESISTANCE TESTING—Directions for testing many specific types of electrical equipment and systems are presented in 50-page manual 13069. Prepared around the use of Vibrotest instruments, the manual covers the field of insulation resistance testing in a simple, how-to-do-it style. It also discusses the value of continuous record-keeping. The literature is free to owners of Vibrotest instruments who request it, giving the model

(Continued on page 70)

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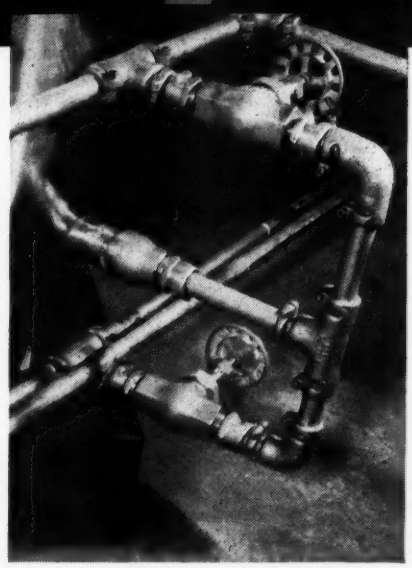

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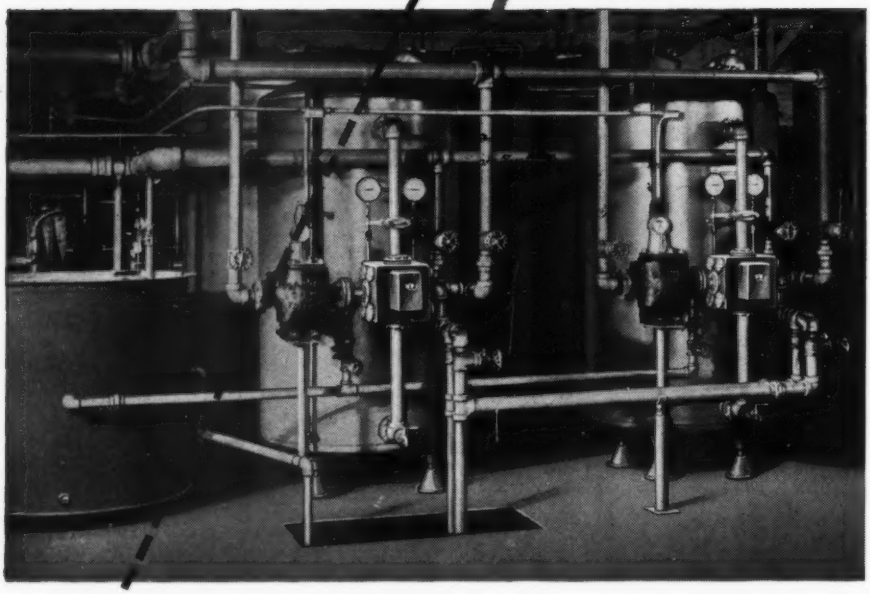

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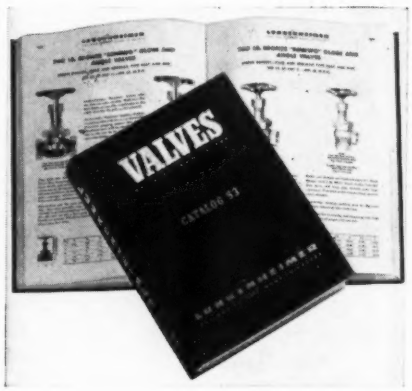
BOOKLETS —*Starts on page 68*

and serial number of their instrument. Price to other interested persons is 50c. *Associated Research, Inc., 3758 W. Belmont Ave., Chicago 18, Ill.*

SPACE HEATERS—How two combination oil and gas fired space heaters solved a problem of cold air inrushing through open doors is described in 4-page case study 560-61. The folder explains how the two heaters are used to provide a heat curtain. In addition, it tells how the units, equipped with duct work to heat a 23,400 sq ft metal working plant, are arranged to permit one heater to carry the load in mild weather. *Heating Dept., Machinery Div., Dravo Corp., Dravo Bldg., Fifth and Liberty Ave., Pittsburgh 22, Pa.*



VALVE PRODUCTS, including steel, iron, and bronze valves, lubricating devices, boiler mountings, and cocks are described in a 506-page catalog. Over 100 pages of reference data are provided. A handy, illustrated and thumb-indexed selector guide groups valves according to pressure classifications to enable the engineer to find specifications, reference data, and code requirements for any valve in a matter of seconds. *The Lunkenheimer Co., P. O. Box 360, Annex Station, Cincinnati 14, Ohio.*

REFRACTORIES — "Calculating Heat Loss Through Furnace Walls of Various Materials," a 4-page article, presents considerable engineering information of value in determining heat losses through various types of furnace construction. Formulas and charts add to the publication's value. *Plibrico Co., 1800 Kingsbury St., Chicago 14, Ill.*

CABLE CONTROLS, both rear- and front-mounted, are the subject of 8-page bulletin 30598. Cutaway and model views facilitate illustration of the advantages of both types. A table lists specifications. *Caterpillar Tractor Co., Peoria 8, Ill.*

consulting engineers' calendar

Date	Sponsor	Event	Location
Sept. 1-4	American Institute of Electrical Engineers	Pacific General Meeting	Hotel Vancouver Vancouver, B.C., Can.
Sept. 1-4	International Assoc. for Hydraulic Research and Hydraulic Division, ASCE	1953 Joint Meeting	Univ. of Minn. Minneapolis, Minn.
Sept. 6-11	American Chemical Society	Fall Meeting	Conrad Hilton Hotel Chicago, Illinois
Sept. 10-12	Rocky Mountain Management Club	Rocky Mountain Industrial Exp.	Univ. of Denver Denver, Colo.
Sept. 13-16	American Institute of Chemical Engineers	Fall Meeting	Fairmont & Hopkins San Francisco, Calif.
Sept. 14-17	Illuminating Engineering Society	National Technical Conf.	Hotel Commodore New York, N.Y.
Sept. 14-18	Michigan State College	Industrial Engr's Conf.	Mich. State College East Lansing, Mich.
Sept. 21-25	Industrial Inst. & Regulator Division American Society of Mechanical Engineers	Exhibit and Conference	Sherman Hotel Chicago, Illinois
Sept. 28-30	National Electronics Conference	9th General Conference	Sherman Hotel Chicago, Illinois
Sept. 28-30	American Society of Mechanical Engineers	Petroleum-Mech. Eng'r Conf.	Rice Hotel Houston, Texas
Oct. 5-7	American Society of Mechanical Engineers	Fall Meeting	Sheraton Hotel Rochester, N. Y.
Oct. 6-8	Elec. League of Western Penn.	4th Industrial Elec. Expo.	William Penn Hotel Pittsburgh, Pa.
Oct. 6-8	American Institute of Electrical Engineers	Fractional HP Motor Conf.	Hotel Keenan Ft. Wayne, Ind.
Oct. 8-9	Illinois Institute of Technology	Conf. on Ind'l Hydraulics	Sherman Hotel Chicago, Ill.
Oct. 17-20	Conveyor Equipment Mfrs. Assoc.	Annual Meeting	Greenbrier, White Sulfur Springs, W. Va.
Oct. 19-23	National Safety Council	National Safety Congress	Conrad Hilton Hotel Chicago, Ill.
Oct. 27	Consulting Chemist and Chem. Eng'rs.	25th Anniversary Meeting	Belmont Plaza Hotel New York, N. Y.
Nov. 9-12	Refrig. Equip. Mfgs. Assoc.	Refrig. & Air Cond. Exp.	Public Auditorium Cleveland, Ohio
Nov. 30-Dec. 5	Exposition of Chemical Industries	Exhibit	Commercial Museum Philadelphia, Pa.

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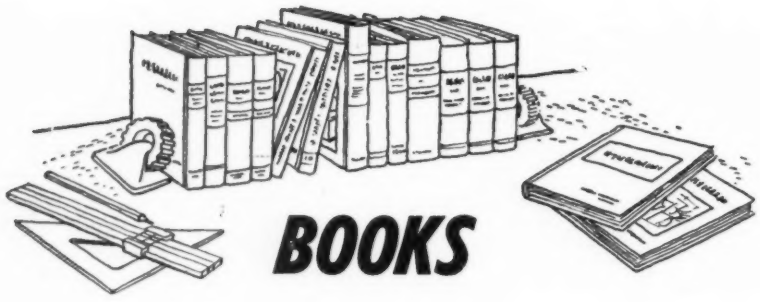

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MATERIALS HANDLING, by John R. Immer; McGraw-Hill Book Co., 590 pages, $8.00.

Reviewed by W. E. Harper
Hapman Conveyors, Inc., Division of Hapman-Dutton Co.

This book is not a "handbook" of materials handling equipment, simply describing the various types of equipment available to industry, nor does it include engineering information and data for the calculation of capacities, chain pulls, or drive horsepower requirements.

Rather, it approaches the subject from a new viewpoint—that of basic problems and applications. This "functional" approach helps the reader to become aware of materials handling problems which might be more costly than realized until properly analyzed as such. This awareness is brought about through introductory chapters on the history of materials handling and its principles, and emphasized further by discussions of work simplification and time and motion study.

Materials handling equipment is discussed specifically in some detail but principally on the basis of general applications such as horizontal fixed routes, overhead movement of materials, vertical movement of materials, horizontal movement—nonfixed path, and industrial storage facilities.

Sections are also included on packaging; how to analyze problems and determine costs; the requirements of the proper organization for the materials handling program; as well as a section on special handling problems. Many photographs and sketches are used to helpfully supplement the text.

The different approach used in this book should make it a valuable adjunct to the industrial bookshelf.

RADIOISOTOPES IN INDUSTRY, edited by John R. Bradford, Reinhold Publishing Corporation, 400 pages, $8.00.

Reviewed by L. Reiffel
Nuclear Physics Section
Armour Research Foundation

Based on a series of lectures presented at Case Institute of Technology, this book represents a commendable effort toward gathering together in one place most of the basic data needed for an evaluation of the utility of radioisotopes in industry. Through its use, the uninitiated should be able to discern the role of radioisotope technique in particular problems and of even more significance, to establish intelligently the economics of employing radioisotopes.

After a series of elementary discussions on the history of radioisotope technique, the text proceeds to review briefly the fundamentals of "radiochemistry" which is perhaps a misnomer, since the major items discussed are the concepts of half-life, radioactive equilibrium, units, decay schemes notation, range-energy relations, and fission processes. The next chapter of the book deals with radiation protection and should serve to make the user aware of the problems involved, but is of doubtful value in providing material for the practical solution of protection problems. These introductory chapters are followed by two lengthy ones on the use of radioisotope techniques. Rather specific problems are treated but sufficient variety is present to fairly well delineate their usefulness.

Having taken the reader to the point where he is probably ready and eager to use the isotopes, the book accommodates by the inclusion of two chapters on the nature of radioisotope laboratory design. The first of these two chapters describes in detail furniture useful in such laboratories. It is written by an author associated with a laboratory furniture manufacturer who is prone to promote the use of stainless steel, and as a consequence, the chapter is rather one-sided in its viewpoint. There are equally useable or even superior building materials for radiochemical laboratory furniture which are not adequately covered. The following chapter, however, is an excellent introduction to the general design of radiochemical laboratories and should be entirely satisfactory for the more casual user of radioactive materials.

The book continues with discussions of production techniques for radioisotopes which are not at present of direct interest to the industrial user, but whose general interest certainly justifies their inclusion. Tracer experimentation, instrumentation, and disposal problems, followed by a discussion of potential industrial uses of radioactive fission products, as distinguished from radioisotopes, follow in logical sequence. The book concludes with a chapter describing the distribution program of the USAEC which should serve to answer the question the author undoubtedly hopes to stimulate in the reader, "We have a use for them, so how do we get started?"

PROCEEDINGS OF THE UNITED STATES TECHNICAL CONFERENCE ON AIR POLLUTION; sponsored by the Interdepartmental Committee on Air Pollution, Louis C. McCabe, Chairman; McGraw-Hill Book Co., 847 Pages, $12.50.

Reviewed by William G. Christy
Consulting Engineer on Air Pollution Control, New York.

This very informative book indicates the broad and comprehensive field covered by air pollution control today. The vast scope of the activities in investigation and control of atmospheric pollution may be partially visualized from glancing at the list of panels at the conference: Agriculture, Analytical Methods and Properties, Equipment, Health, Instrumentation, Legislation, and Meteorology. There were 97 papers presented at the three day conference. One day was devoted to general sessions at which summaries of all the panels were given. All the papers are in this volume together with extensive discussions and references.

Progress in this field has been rapid in recent years. Thirty years ago only a comparatively few American cities were actively fighting pollution of the air. The main concern was smoke emissions from chimneys with some attention given to soot and cinders. Many ordinances covered only black smoke. Burning coal in pulverized form was

barely past the experimental stage, and the fly ash nuisance was just beginning. Today hundreds of municipalities as well as several counties have entered the fight for pure air. Some States have passed legislation and others have bills pending. Regional, interstate and even international regulations are being actively discussed.

Every form of atmospheric pollution is the concern of public officials, engineers, scientists, physicians, industrialists, and civic minded citizens. Research in many phases of the problem is being carried on by numerous groups and institutions. Dr. McCabe is an authority in this field. His book is by far the most comprehensive yet published.

This Conference has set the pattern for many local, regional, and national conferences and symposia on air pollution, arranged by technical and scientific societies, industrial organizations, and research and educational institutions. All those who want to be brought up-to-date in this activity will find Dr. McCabe's book of great value.

ALSO AVAILABLE

CATALOG OF ISOTOPES, Oak Ridge National Laboratory, $1.00. This new catalog of isotopes, both radioactive and stable, replaces a previous edition published by the Atomic Energy Commission in March, 1951. More than 100 radioactive and 175 stable isotopes are listed in the new catalog together with prices and descriptive material. Prices range from as low as $5.00 per curie for radioactive cobalt to $5.00 a microcurie for radioactive chlorine.

MAXIMUM PERMISSIBLE AMOUNTS OF RADIOISOTOPES IN THE HUMAN BODY AND MAXIMUM PERMISSIBLE CONCENTRATIONS IN AIR AND WATER, National Bureau of Standards, 45 pages, 20c. The report considers about 70 or 80 isotopes that are of present-day interest and discusses in detail methods of estimating maximum permissible amounts and concentration factors that determine the hazards of radioisotopes and recommendations for avoiding or minimizing the hazards.

TRANE AIR CONDITIONING MANUAL, The Trane Company, 380 pages, $5.00. This new edition has a chapter on fans added to cover application and selection, basic fan laws, and design data and nomenclature. This is the 16th printing and the second major revision of the manual since 1938. It has long been popular with engineers and contractors and has been used as a standard text reference book on air conditioning by colleges. The new fan chapter is available separately at $1.00.

INDUSTRIAL FILMS

"National Directory of Films," has been published by the National Safety Council in a 1953-1954 edition. The directory provides the plant safety man with a comprehensive listing of 963 motion pictures and slide films for use in training personnel in occupational accident preventions. Copies of the directory are available for 75¢ from National Safety Council, 425 N. Michigan Ave., Chicago, 11, Ill.

"Industrial Film Bibliography," National Metal Trades Association has recently published a supplement to their bibliography of industrial films. This listing is said to be the most complete compilation of its kind. Bibliography may be had for $2.00 from NMTA headquarters, 122 S. Michigan Ave., Chicago 3, Ill. Supplement is available for 50¢.

"The Inside Story," sound, 16 mm, 15 minutes, Atlas Powder Co., Wilmington, Delaware. This technical film shows how modern methods make blasting an orderly and controlled sequence of events precisely adaptable to the type of rock, the surroundings, and the specific results desired. Where complete discussions are desired, film may be supplemented by slides showing special types and methods of blasting in sequence pictures.

"The Metalworking Lathe," "Plain Turning," and "Grinding Cutter Bits," three separate sound and color films, 16 mm, 20 minutes each. South Bend Lathe Works, 425 E. Madison St., South Bend 22, Ind. These films on various phases of metalworking are designed for industrial or vocational classes to impress trainees with proper machine handling and care as well as operator safety. Bulletin 5230 is available, describing the three films.

"Contact," sound and color, 16-mm, Cannon Electric, 420 West Avenue 33, Los Angeles 31, California. This film is designed as a training and orientation aid for those in the electrical, electronic, and aircraft fields who need to understand the functioning and servicing of multicontact elector connectors. It shows Cannon plug applications in such diversified industries as geophysical prospecting, aircraft, radio, and oil field production.

"Hold Everything," sound and color, 16 mm, 20 minutes, Allen Manufacturing Co., Hartford 2, Conn. This is the first Kodachrome movie to be filmed about Allen socket screws. It describes the important differences between socket screws and other types and the advantages of this type.

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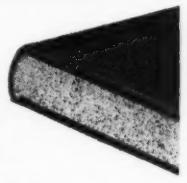

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